Georgia – SDSU: Degree Accreditation and Institutional Support Initiative for Science, Technology, Engineering, and Mathematics (Georgia 2020)

Appendix

Submitted to

MCC Georgia

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by

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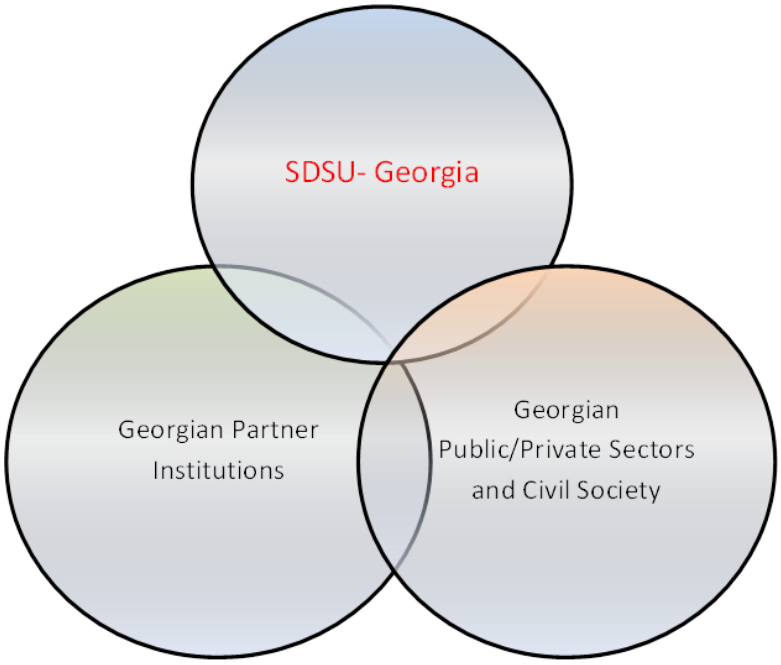

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Appendix 1 - Additional courses taught in English at Tbilisi State University for consideration as General Education courses.

EU Law
History of Europe
EU Governance and Policy Making Process
Economics of EU Integration
Public Policy Analysis
Theories of EU Integration
Theory of Law
European Court of Human Rights
EU Georgia Cooperation under Justice, Liberty, Security format
Qualitative Research Methods
Quantitative Research Methods-Introduction to Applied Statistics
International Economics
Transformation in the South Caucasus
Public Policy Analysis
Theories of International Relations
Regional Conflict and Security in the South Caucasus
International Security
Foreign Policy of Russia
Theory and Method in IR
Comparative Politics: From Authoritarianism to Democracy with Adjectives
Nationalism Studies: Theory and Practice
Political problems in the Middle East
European Neighborhood Policy
Ethnography of Georgia
History of Ethnology in Georgia
Georgian Mythology
Introduction to Folkloristic
History of development of Ethnology in Georgia
Georgian Ethnological Heritage
Georgian Language
Russian Language
French Language
English Language
German Language
Industrial Organization
International Trade
Time Series II
Labor Economics II
Agricultural Economics
Philosophy of Social Sciences
International Organizations and European Politics in the South Caucasus
Political History of USSR
Public Policy in the developed and developing Countries
International Peace and War
Post-Soviet Politics
Foreign Policy Analysis
Culture and Identities in Changeable Society
EU Democratization in the Post-Soviet States
History of European Integration
Remembering the Soviet Past in Georgia: Between Memory and History
Georgian Language
Russian Language
French Language
English Language
German Language

Appendix 2 – Ilia State University Civil Engineering Draft Curriculum

Faculty	*Ilia State University School of Engineering*
Program Title	*Civil Engineering (CIVEN)* - D R A F T
Academic Degree Acquired	*Bachelor of Science (B.S.E.) in Civil Engineering*
Program Duration	*8 semesters – 240 ECTS credits (1 ECTS – 25 Hours).* *Major program – 120 ECTS, elective courses – 60* *Minor Module – 60* *1 credit volume - 25 hours*
Language of Instruction	*Georgian*

Admissions

Prospective students are required to fulfill general requirements of the School of Engineering: pass the Unified National Exams by scoring at the benchmark level or higher on the General Aptitude, Georgian Language, English Language, and Mathematics tests (4 exams).

Purpose & Objectives of the Program

Bachelor's(B.S.E.) degree program is designed to teach Civil Engineering students the fundamental and basic concepts, connection and wide range of applications, methods and technologies; particularly:

Civil Engineering Program aims at teaching students design, plan, and improve the built environment and infrastructures (buildings, water supply, roadways, pipeline, railroads and other networks, power generation facilities, pollution control works, flood protection structures, dams, and canals, airports, ports etc.). This discipline encompasses several sub-disciplines, such as: hydraulics and hydrology, structural, geotechnical, construction, environmental, civil engineering materials, transportation engineering and others. Program will also address closely related environmental issues, such as impact of human activities on the environment and vice versa (design of technologies to remove contaminants from drinking water, soils, monitor and mitigate greenhouse gas compounds, recover resources and energy from waste and design alternative energy sources, clean hazardous waste sites, mitigate and/or restore environment damaged by human activities, etc.).

Learning outcomes and competencies (General and field-specific)

1.Field-Specific Knowledge and Awareness:

- General knowledge in environmental structure systems, their interaction and main parameters;
- Basic knowledge on major structures of built environment;
- Knowledge on critical issues of human-environmental interaction, natural and anthropogenic changes in environment;
- Bases for deepening their knowledge in any specific field of Civil and Environmental Engineering.

2.Knowledge Application:

- Complex construction/ Infrastructure design projects
- Soil, air, water and wastewater treatment;
- Renewable Natural resources;
- Hazardous waste management;
- Coastal dynamics;
- Assessment and monitoring of critical infrastructures.

3. Critical Thinking Skills - Program graduates will:

- Have effective problem solving skills;
- Be able to conduct information analysis and synthesis;
- Be able to give well-grounded arguments and draw logical conclusion based on available data and information.

4. Communication skills - Program graduates will:

- Be able to communicate on field specific topics in Georgian and English with professional and non-professional audience;
- Be able to effectively master professional information;
- Be able to present report as the end-results of their professional performance;
- Be able to effectively and purposefully use modern communication technologies.

5. Learning skills - Program Graduates will:

- Be able to independently acquire knowledge and further develop their professional skills in the area of their choice. Critical thinking skills developed and knowledge acquired within the framework of the undergraduate program will allow students to further pursue their graduate studies in relevant fields;
- Be able to process new literature in the fields of Environment, Engineering, Chemistry, and Bio-technology. They will be able to use modern resources for information research and independently master new field-specific knowledge.

6. Values

- During their studies, students will develop professional values and become aware of professional ethical requirements. The latter will specifically concern cases of information storage and processing as a result of their professional performance.
- The program graduates will be able to work in teams and effectively run projects with pre-defined practical recommendations and instructions.
- Program graduates will be able to participate in establishment of liberal values that will be implanted in their professional performance.

Program Structure

Bachelor degree Program in Civil Engineering- CIVEN consists of:
General module – 60 Credits;
Major Program – 120 Credits;
Environmental Engineering Concentration – 60 Credits;

Civil Engineering program consists of 3 modules:

1.Introductory Module of School of Engineering - INTRO

2. Major module of Civil Engineering - CIVEN
3. Environmental Engineering Module - ENVEN

During the first year of their studies students are required to take General module coded INTRO subjects and 4 introduction subjects proposed by the School of Engineering including 2 required courses from the module of Introductory Module of School of Engineering which will be considered as the selected direction credits (3 credits each).

In the beginning of second year student selects its direction by choosing the mandatory and elective courses of specific direction.

The student of **Civil Engineering** program is obliged to collect:

Requirements for Major Program (120 credits)

- From the University General introductory courses with code INTRO – 6 credits;
- From the Introductory course modules of School of Engineering with code INTROENG – 6 credits;
- From the Main Civil Engineering program, core (mandatory) courses with codes CIVENGEN– 48 Credits, and from elective courses with codes 0/CIVEN -60 Credits, total 108;

Requirements for the Geosciences (Environmental Engineering) concentration (60 credits)

- From the Environmental Engineering concentration, core courses with codes ENVENGEN– 24 Credits and from elective courses with code 0/ENVEN -36 Credits, in total 60 credits

Teaching Methods

Lectures
Seminars
Colloquium
Presentations
Independent work
Group work
Lab works
Practical Work

Evaluation rules

Evaluation rule (100 points)
(A) 91 - 100 excellent
(B) 81 - 90 very good
(C) 71 - 80 Good
(D) 61 - 70 Satisfactory
(E) 51 - 60 Sufficient
(FX) 41 - 50 not passed, a student can sit the final exam once again;

(F) 0 - 40 failed, a student is required to take the course again

Employment Perspectives

Ongoing construction Projects, such as highways, tunnels, dams and other critical facilities; Private construction or consulting companies; Government bodies: Ministries of Energy, Environment and Infrastructure, Local municipalities. Agencies and inspections of Monitoring and assessment of existing critical facilities, various NGOs, Universities and other educational organizations, Scientific institutions, laboratories, etc.

Necessary support conditions/resources for learning

- Computer Class and necessary software
- Lecture classrooms
- Study Labs (rocks and materials mechanical testing, water chemical analysis etc.)
- Geotechnical and Geophysical and Geochemical equipment for fieldwork
- University Library/Online Library
- Student's Registration and Learning Process Network - ARGUS
- Academic Advisor

#	Courses	Code	Mandatory / Elective	Credits	Contact Hours	Prerequisites	Fall	Spring
GENERAL MODULE (taught at first year at the School of Engineering)								
General module of School of Engineering								
1	Calculus 1	GEN	Man.	6	33		x	
2	Calculus 2	GEN	Man.	6	33	Calculus 1		x
3	Chemistry 1	GEN	Man.	6	33		x	
4	Presentation and Communication Skills	GEN	Man.	6	33		x	
5	Physics (Calculus based) 1	GEN	Man.	6	33			x
6	Probability and Statistics	GEN	Man.	6	33	Calculus 1		x
7	ELPC - English Language Practical Course (Starter)	GEN	Man/Elect	6	92		x	x
8	ELPC (Elementary)	GEN	Man/Elect	6	92		x	x
9	ELPC (Pre-Intermediate)	GEN	Man/Elect	6	92		x	x
10	ELPC (Intermediate 1)	GEN	Man/Elect	6	92		x	x
11	ELPC (Intermediate 2)	GEN	Man/Elect	6	92		x	x
12	ELPC (Upper Intermediate 1)	GEN	Man/Elect	6	92		x	x
13	ELPC (Upper Intermediate 2)	GEN	Man/Elect	6	92		x	x
14	ELPC (Advanced 1)	GEN	Man/Elect	6	92		x	x
15	ELPC (Advanced 2)	GEN	Man/Elect	6	92		x	x
Introductory Module of School of Engineering								
1	Planetary Geophysics	INTRO	Elect.	3	33		x	x
2	Origin and Evolution of the Universe	INTRO	Elect	3	33		x	x
3	Historical Earthquakes (Archaeo-Seismology)	INTRO	Elect	3	32		x	x

4	Earth's structure and Theory of Plate Tectonics	INTRO	Elect	3	34		x	x
5	Natural monuments of Georgia	INTRO	Elect	3	33		x	x
6	Geological and Paleontological Basis of Evolution Theory	INTRO	Elect	3	33		x	x
7	Vital Resources of Modern Civilization of Earth	INTRO	Elect	3	33		x	x
10	History of Earth	INTRO	Elect	3	32		x	x
11	Introduction to Architecture	INTRO	Elect	3	68		x	
12	Introductory Course to Architecture (Composition, Idea, Form)	INTRO	Elect	3	45			x
13	Introduction to Design	INTRO	Elect	3	68			x
14	Space and Time as Viewed by Modern Physics	INTRO	Elect	3	32		x	
15	Solved and Unsolved Mysteries of Science	INTRO	Elect	3	32		x	
16	Elementary Particles and Forces of Nature	INTRO	Elect	3	32		x	x
17	Cosmology –Theory of the origin and evolution of the world	INTRO	Elect	3	32		x	x
18	From Zoroastrianism to Artificial Intelligence	INTRO	Elect	3	32		x	
19	Physics of Micro world - Basics of quantum physics	INTRO	Elect	3	32			x
20	Contemporary Physics in Modern Technologies	INTRO	Elect	3	32			x
21	Biophysics and Biotechnology	INTRO	Elect	3	32			x
22	The Role of Nature's Laws in Our Life	INTRO	Elect	3	32			x
23	The Mysteries of Micro and Macro world	INTRO	Elect	3	32			x
24	Introduction to Microelectronics and Robotics	INTRO	Elect.	3	33		x	x
25	Introduction to Information Technologies	INTRO	Elect.	3	34		x	x
26	Introduction to Software Development	INTRO	Elect.	3	37		x	x

Appendix 3 – Ilia State University Architecture Curriculum

Faculty	Ilia State University School of Engineering
Program Title	Architecture
Academic Degree Acquired	Bachelor of Architecture
Program Duration	8 semesters – 240 ECTS credits (1 ECTS – 25 Hours). Major program – 120 ECTS, General module – 60
Language of Instruction	Georgian
Admissions	
Unified National Exams 4th exam – Mathematics	
Program Objectives	
The aim of the program is to equip students with essential knowledge and skills in the chosen field for acquiring Bachelor level architectural education. Students will obtain knowledge and skills for applying modern technologies in design and construction process, critical analysis of project and working in team of field related specialists. The programs aims at preparation of students for successful career and impart the specialized knowledge and hands-on experience to equip them with transferable skills as critical thinking, original decision-making, effective communication skills in foreign language with professional and non professionals of the field, skills of effective usage of technology. The program is aimed at development of liberal arts values, which will help students to succeed in society and professional careers.	

#	Courses	Credits
General Module		
1	Introduction to Modern thinking I	6
2	Introduction to Modern thinking II	6
3	Mathematics 1	6
4	Mathematics 2	6
5	Academic Writing	6
6	Presentation, Communication and Discussion Techniques	6
7	English Language Practical Course (Starter)	6
8	English Language Practical Course (Elementary)	6
9	English Language Practical Course (Pre-Intermediate)	6
10	English Language Practical Course (Intermediate 1)	6

11	English Language Practical Course (Intermediate 2)	6
12	English Language Practical Course (Upper Intermediate 1)	6
13	English Language Practical Course (Upper Intermediate 2)	6
14	English Language Practical Course (Advanced 1)	6
15	English Language Practical Course (Advanced 2)	6
Module of Introductory Courses		
1	Introduction to Microelectronics and Robotics	3
2	Introduction to Software Development	3
3	Introduction to Information Technologies	3
4	Planetary Geophysics	3
5	Origin and Evolution of the Universe	3
6	Historical Earthquakes (ArcheoSeismology)	3
7	volcanoes, caves, waterfalls of Georgia	3
8	Geological and Paleontological Basis of Evaluation Theory	3
9	Vital Resources of Modern Civilization of Earth	3
11	Introduction to Architecture	3
12	Introductory Course to Architecture (Composition, Form, Idea)	3
13	Introduction to design	3
14	Space and Time as Viewed by Modern Physics	3
15	Solved and Unsolved Mysteries of Science	3
16	Elementary Particles and Forces of Nature	3
17	Cosmology – Theory of the origin and evolution of the world	3
18	From Zoroastrianism to Artificial Intelligence	3
19	Physics of Microworld - Basics of quantum physics	3
20	Contemporary Physics in Modern Technologies	3
21	Biophysics and Biotechnology	3
22	The Role of Nature's Laws in Our Life	3
23	The Mysteries of Micro and Macro world	3
Architecture Concentration		
III Semester	Architectural Forms and Types	6
	Composition - Drawing Geometry	6
	Painting, Sculpture 1	6
IV Semester	History of Art Development	6
	Design 1 + Process of Design and Communication	6
	Painting	6
V Semester	History of Georgian Architecture - Feudal Period 1	6
	Integrated Design 2 (Construction, design)	6

	landscape Architecture + painting - graphical tools for landscape designs	6
VI Semester	Integrated Design - 3 (urban planning + construction + Lighting + Acoustics)	6
	History of Georgian Architecture - Feudal Period 2	6
	Urban Planning	6
VII Semester	Studio 4 - Research + Design Assignment	6
	History of Modern Architecture	6
VIII Semester		6
Elective Courses		
1	Conceptual Design	6
2	Professional Context	6
3	ArchiCAD	6
4	AutoCAD	6
5	Revit	6
6	Seminar in Modern Architecture	6
7	Modern wooden materials and technologies	6
8	Reconstruction/restoration – Design	6
9	Landscape Architecture + Painting	6
10	Georgian House	6
11	Photography	6
12	Usage of secondary materials in design	6

Appendix 4 - Tbilisi State University Chemistry Curriculum

Curriculum in Chemistry

#	Subjects	ECTS	hours	Lecture/Practical/Laboratory/Working group	Contact/Independent Working Hours	Precondition	Semester							
							I	II	III	IV	V	VI	VII	VIII
Faculty compulsory subjects (20 Credits)														
1	Foreign Language 1	5	4		60/65			5						
2	Foreign Language 2	5	4		60/65				5					
3	Calculus IV	5	4	2/2/0/0	60/65		5							
4	Computer Skills	5	2	0/0/0/2	30/95		5							
Faculty Elective Subjects (5+5+5+5=20 Credits)														
5	The Introduction of Chemistry	5	4	2/2/0/0	60/65	-	5							
6	The Introduction of Physics	5	4	2/2/0/0	60/65		5							
7	The Introduction of Biology	5	4	2/2/0/0	60/65		5							
8	The Introduction of Geography	5	4	2/2/0/0	60/65		5							
9	The Introduction of Geology	5	4	2/2/0/0	60/65		5							
	Basics of Programming	5	4	2/2/0/0	60/65		5							
	The Introduction of Electronics	5	4	2/2/0/0	60/65		5							
	Linear Algebra and Analytical Geometry	5	4	2/2/0/0	60/65		5							
Compulsory subjects of Specialization (90 Credits)														
10	General Chemistry	10	8	2/0/4/2	120/130	-		10						
11	Inorganic Chemistry	10	8	2/0/4/2	120/130	10			10					
12	Physics	5	4	2/2/0/0	60/65	-		5						

13	High Mathematics	5	4	2/0/0/2	60/65	3		5						
14	Physical Chemistry-1	5	4	2/0/1/1	60/65	10			5					
15	Physical Chemistry-2	5	4	2/0/1/1	60/65	14				5				
16	Physical Chemistry -3	5	4	2/0/1/1	60/65	10					5			
17	Physical Chemistry-4	5	4	2/0/1/1	60/65	10						5		
18	Analytical Chemistry-1	5	4	2/0/1/1	60/65	10				5				
19	Analytical Chemistry-2	5	4	2/0/1/1	60/65	18					5			
20	Organic Chemistry- 1	10	8	2/0/4/2	120/130	10				10				
21	Organic Chemistry- 2	5	4	2/0/1/1	60/65	20					5			
22	Metalorganic Chemistry	5	4	1/0/2/1	60/65	11, 20							5	
23	Macromolecular Chemistry	5	4	2/0/1/1	60/65	20							5	
24	Biological Chemistry	5	4	2/0/1/1	60/65	11, 20								5
	Elective Subjects of Specialization (15 Credits, 3 Subjects)													
25	Applied Chemistry	5	3	1/2/0/0	45/80	11, 20						5		
26	Agricultural Chemistry	5	3	2/0/0/1	45/80	11, 20						5		
27	Quantum Chemistry	5	3	2/00/1	45/80	10, 12							5	
28	Analysis of Mineral Raw Materials	5	3	2/0/1/1	45/80	19							5	
29	Polymeric Materials	5	3	1/0/2/0	45/80	20								5
30	Petrochemical Processes	5	3	2/0/0/1	45/80	20								5
	Compulsory subjects of Moduls of Specialization (30 Credits, 6 Subjects)													
31	Instrumental methods of Separation of Mixtures	5	3	2/0/0/1	45/80	10			5					
32	Environmental Chemistry	5	3	2/0/1/0	45/80	10			5					
33	Chemistry of Hazardous Substances	5	3	2/0/0/1	45/80	11, 20						5		
34	Practical Organic Chemistry–Organikum	5	4	1/0/3/0	60/65	20						5		
35	Bioorganic Chemistry	5	3	2/0/0/1	45/80	20							5	
36	Practicum in Macromolecular Chemistry	5	4	1/0/3/0	60/65	23								5
	Specilization Modul “Chemistry” Elective Subjects (30 კრედიტი)													
37	Chemistry of Mineral Raw Materials	5	3	2/0/0/1	45/80	11				5				
38	General Stereochemistry	5	3	2/0/0/1	45/80	20					5			
39	Chemistry of Natural Compounds	5	3	1/0/2/0	45/80	20					5			

40	Chemical Methods of Investigaton of Environment	5	3	2/0/1/0	45/80	18						5		
41	Bioinorganic Chemistry	5	3	2/0/0/1	45/80	11						5		
42	Selected Chapters of Chemical Kinetics	5	3	2/0/0/1	45/80	11							5	
Specilization Modul "Pharmacochemistry" Compulsory subjects (15 Credits, 3 Subjects), Elective Subjects (15 Credits, 3 Subjects from Elective Subjects of Chemistry Modul or from Elective Subjects of Specilization)														
43	Pharmaceutical Chemistry-1	5	3	2/0/0/1	45/80	11, 18, 20				5				
44	Pharmaceutical Chemistry-2	5	3	2/0/1/0	45/80	43					5			
45	Pharmacognosy	5	3	2/0/0/1	45/80	43						5		
Specilization Modul "Petrochemistry" Compulsory Subjects (15 Credits, 3 Subjects), Elective Subjects (15 Credits, 3 Subjects from Elective Subjects of ChemistryModul or from Elective Subjects of Specialization)														
46	Chemistry of oil and natural gases-1	5	3	2/0/0/1	45/80	20				5				
47	Chemistry of oil and natural gases-2	5	3	1/0/2/0	45/80	46					5			
48	Petrochemical Synthesis	5	3	2/0/0/1	45/80	20						5		
Specilization Modul "Chemical Expertise" Compulsory Subjects (20 Credits, 4 Subjects), Elective Subjects (10 Credits, 2 Subjects from Elective Subjects of ChemistryModul or from Elective Subjects of Specialization)														
49	Methods of Chemical Expertise-1	5	3	2/0/0/1	45/80	10				5				
50	Methods of Chemical Expertise-2	5	3	2/0/0/1	45/80	49					5			
51	Control and Expertise of Environment	5	3	1/0/2/0	45/80	18						5		
52	Analysis and Expertise of Building and Construction Materials	5		1/0/2/0	45/80	23							5	
53	Bachelor's Work	5												5
54	Labour Protection and Safety	5	4	2/1/0/1	60/65	–								5
55	Industrial Practicum	5												5
Free Elective Subjects (20 Credits, 4 Subjects)														
56	History of Chemistry	5	3	2/0/0/1	45/80			5						
57	Chemistry and Civilization	5	3	2/0/0/1	45/80								5	
58	Free Elective Subject	5	3	2/0/0/1	45/80					5				
59	Free Elective Subject	5	3	2/0/0/1							5			
Specilization Modul "Pedagogics" Compulsory subjects (25 Credits 5 Subjects)														

Elective Subject (5 Credits, 1 Subject from Elective Subjects of ChemistryModul or from Elective Subjects of Specialization)															
60	Pedagogics	5	3	2/1/0/0	45/80						5				
61	Psychology of Education	5	3	2/1/0/0	45/80						5				
62	Theories of Education and Teaching	5	3	2/1/0/0	45/80							5			
63	Psychology of Development of Child and Young Adult	5	3	2/1/0/0	45/80							5			
64	Methods of Teaching of Chemistry	5	3	2/0/1/0	45/80	10,11, 20							5		
	Sum: 240														

Appendix 5 - Tbilisi State University Chemistry Curriculum

Curriculum in Chemistry

#	Subjects	ECTS	hours	Lecture/Practical/Laboratory/Working group	Contact/Independent Working Hours	Precondition	Semester							
							I	II	III	IV	V	VI	VII	VIII
Faculty compulsory subjects (20 Credits)														
1	Foreign Language 1	5	4		60/65			5						
2	Foreign Language 2	5	4		60/65				5					
3	Calculus IV	5	4	2/2/0/0	60/65		5							
4	Computer Skills	5	2	0/0/0/2	30/95		5							
Faculty Elective Subjects (5+5+5+5=20 Credits)														
5	The Introduction of Chemistry	5	4	2/2/0/0	60/65	-	5							
6	The Introduction of Physics	5	4	2/2/0/0	60/65		5							
7	The Introduction of Biology	5	4	2/2/0/0	60/65		5							
8	The Introduction of Geography	5	4	2/2/0/0	60/65		5							
9	The Introduction of Geology	5	4	2/2/0/0	60/65		5							
	Basics of Programming	5	4	2/2/0/0	60/65		5							
	The Introduction of Electronics	5	4	2/2/0/0	60/65		5							
	Linear Algebra and Analytical Geometry	5	4	2/2/0/0	60/65		5							
Compulsory subjects of Specialization (90 Credits)														
10	General Chemistry	10	8	2/0/4/2	120/130	-		10						
11	Inorganic Chemistry	10	8	2/0/4/2	120/130	10			10					
12	Physics	5	4	2/2/0/0	60/65	-		5						

13	High Mathematics	5	4	2/0/0/2	60/65	3		5						
14	Physical Chemistry-1	5	4	2/0/1/1	60/65	10			5					
15	Physical Chemistry-2	5	4	2/0/1/1	60/65	14				5				
16	Physical Chemistry -3	5	4	2/0/1/1	60/65	10					5			
17	Physical Chemistry-4	5	4	2/0/1/1	60/65	10						5		
18	Analytical Chemistry-1	5	4	2/0/1/1	60/65	10				5				
19	Analytical Chemistry-2	5	4	2/0/1/1	60/65	18					5			
20	Organic Chemistry- 1	10	8	2/0/4/2	120/130	10				10				
21	Organic Chemistry- 2	5	4	2/0/1/1	60/65	20					5			
22	Metalorganic Chemistry	5	4	1/0/2/1	60/65	11, 20							5	
23	Macromolecular Chemistry	5	4	2/0/1/1	60/65	20							5	
24	Biological Chemistry	5	4	2/0/1/1	60/65	11, 20								5
	Elective Subjects of Specialization (15 Credits, 3 Subjects)													
25	Applied Chemistry	5	3	1/2/0/0	45/80	11, 20						5		
26	Agricultural Chemistry	5	3	2/0/0/1	45/80	11, 20						5		
27	Quantum Chemistry	5	3	2/00/1	45/80	10, 12							5	
28	Analysis of Mineral Raw Materials	5	3	2/0/1/1	45/80	19							5	
29	Polymeric Materials	5	3	1/0/2/0	45/80	20								5
30	Petrochemical Processes	5	3	2/0/0/1	45/80	20								5
	Compulsory subjects of Moduls of Specialization (30 Credits, 6 Subjects)													
31	Instrumental methods of Separation of Mixtures	5	3	2/0/0/1	45/80	10			5					
32	Environmental Chemistry	5	3	2/0/1/0	45/80	10			5					
33	Chemistry of Hazardous Substances	5	3	2/0/0/1	45/80	11, 20						5		
34	Practical Organic Chemistry–Organikum	5	4	1/0/3/0	60/65	20						5		
35	Bioorganic Chemistry	5	3	2/0/0/1	45/80	20							5	
36	Practicum in Macromolecular Chemistry	5	4	1/0/3/0	60/65	23								5
	Specilization Modul “Chemistry” Elective Subjects (30 კრედიტი)													
37	Chemistry of Mineral Raw Materials	5	3	2/0/0/1	45/80	11				5				
38	General Stereochemistry	5	3	2/0/0/1	45/80	20					5			
39	Chemistry of Natural Compounds	5	3	1/0/2/0	45/80	20					5			

40	Chemical Methods of Investigaton of Environment	5	3	2/0/1/0	45/80	18						5		
41	Bioinorganic Chemistry	5	3	2/0/0/1	45/80	11						5		
42	Selected Chapters of Chemical Kinetics	5	3	2/0/0/1	45/80	11							5	
Specilization Modul "Pharmacochemistry" Compulsory subjects (15 Credits, 3 Subjects), Elective Subjects (15 Credits, 3 Subjects from Elective Subjects of Chemistry Modul or from Elective Subjects of Specilization)														
43	Pharmaceutical Chemistry-1	5	3	2/0/0/1	45/80	11, 18, 20				5				
44	Pharmaceutical Chemistry-2	5	3	2/0/1/0	45/80	43					5			
45	Pharmacognosy	5	3	2/0/0/1	45/80	43						5		
Specilization Modul "Petrochemistry" Compulsory Subjects (15 Credits, 3 Subjects), Elective Subjects (15 Credits, 3 Subjects from Elective Subjects of ChemistryModul or from Elective Subjects of Specialization)														
46	Chemistry of oil and natural gases-1	5	3	2/0/0/1	45/80	20				5				
47	Chemistry of oil and natural gases-2	5	3	1/0/2/0	45/80	46					5			
48	Petrochemical Synthesis	5	3	2/0/0/1	45/80	20						5		
Specilization Modul "Chemical Expertise" Compulsory Subjects (20 Credits, 4 Subjects), Elective Subjects (10 Credits, 2 Subjects from Elective Subjects of ChemistryModul or from Elective Subjects of Specialization)														
49	Methods of Chemical Expertise-1	5	3	2/0/0/1	45/80	10				5				
50	Methods of Chemical Expertise-2	5	3	2/0/0/1	45/80	49					5			
51	Control and Expertise of Environment	5	3	1/0/2/0	45/80	18						5		
52	Analysis and Expertise of Building and Construction Materials	5		1/0/2/0	45/80	23							5	
53	Bachelor's Work	5												5
54	Labour Protection and Safety	5	4	2/1/0/1	60/65	–								5
55	Industrial Practicum	5												5
Free Elective Subjects (20 Credits, 4 Subjects)														
56	History of Chemistry	5	3	2/0/0/1	45/80			5						
57	Chemistry and Civilization	5	3	2/0/0/1	45/80								5	
58	Free Elective Subject	5	3	2/0/0/1	45/80					5				
59	Free Elective Subject	5	3	2/0/0/1							5			
Specilization Modul "Pedagogics" Compulsory subjects (25 Credits 5 Subjects)														

Elective Subject (5 Credits, 1 Subject from Elective Subjects of ChemistryModul or from Elective Subjects of Specialization)															
60	Pedagogics	5	3	2/1/0/0	45/80						5				
61	Psychology of Education	5	3	2/1/0/0	45/80						5				
62	Theories of Education and Teaching	5	3	2/1/0/0	45/80							5			
63	Psychology of Development of Child and Young Adult	5	3	2/1/0/0	45/80							5			
64	Methods of Teaching of Chemistry	5	3	2/0/1/0	45/80	10,11, 20							5		
	Sum: 240														

Iv.Javakhishvili Tbilisi State University
Faculty of Exact and Natural Sciences
Department of Computer Sciences

Bachelor's Program

Computer Science

Graduates will be awarded the academic degree of:

Bachelor of Informatics

Programme requirements:

a) The bachelor program gives the opportunity to combine the **major and minor courses.**

b) The Aim of the bachelor program is to aquire the following skills to the students:

- **A systematic approach to the subject.** General and systematic understanding of the fundamental theoretical principles and concepts of Computer Science and their applications;
- **Deep understanding of the main methods in Computer Science.** The alumni schould apply and implement these methods in practice;
- **Skills for participation in large (Group) projects.** In order to develop special skills to effectively apply theoretical knowledge in practice, it is very important for the students to have some experience of participation in real projects;
- **Flexibility.** In the light of a fast development of technologies in Computer Science, the students should be equipped with solid fundamental knowledge of the subject in order to be able to estimate the actuality of new trends and easily adopt them.

c) Results:

Specific Skills	General Skills
1. Deep knowledge of the fundamental concepts of Computer Science, basic algorithm design, modern programming languages, and basic principles of hardware design; 2. Database development and algorithm design for real-word problems; 3. Software design and testing in one of the modern programming language; 4. Ability to use modern hardware systems in the solution of a given problem.	**Kognitive Skills:** Ability to analyze and classify a problem as well as motivated decision marking; **Technological Skills:** Ability to use communicational and informational technologies to gather and process relevant information and represent the processing results; **Linguistic skills:** Ability to easily represent the conclusions of logical reasoning both in written and spoken forms.

d) Program Structure:

The program provides the possibility to choose the Major (obligatory), Minor and Free lectures.

The Major program includes the so called University courses, Faculty courses and the core and electivre courses in the main subject (see appendix), 160 ECT in total: Elective Courses – 40 ECT, Main (core) courses – 120 ECT, among them 10 ECT for a group project, and 30 ECT for faculty courses.
Free Courses: 20 ECT
Minor Courses: 60 ECT

Curriculum
Faculty of Exact and Natural Sciences
Department of Computer Sciences
Name of the study program: Computer Science

The effective date of the study program (academic year): 2011-2015

Faculty courses / modules						
Faculty (core) compulsory courses / modules						
	Name of the course / module	**ECTS**	**Contact/ independent work hours lecture / practice / seminar / laboratory**	**Requirements for admission to the course / module**	**Semesters of the study (Autumn / Spring)**	**Lecturer / Lecturers**	**Recommended Semester**
	Foreign Language	10	120/130 0/4/0/0		Autumn, Spring		II, III
	Computer skills and IT	5	30/95 0/0/0/2		Autumn		I
	Calculus 2	5	60/65 2/2/0/0		Autumn		I
Faculty (core) elective courses / modules							
	Name of the course / module	**ECTS**	**Contact/ independent work hours lecture / practice / seminar / laboratory**	**Requirements for admission to the course / module**	**Semesters of the study (Autumn / Spring)**	**Lecturer / Lecturers**	**Recommended Semester**
	Introduction to Physics	5	60/65 2/2/0/0		Autumn		I
	Introduction to Chemistry	5	60/65 2/2/0/0		Autumn		I
	Introduction to Electronics	5	60/65 2/2/0/0		Autumn		I
	Introduction to Biology	5	60/65 2/2/0/0		Autumn		I
	Introduction to Geography	5	60/65 2/2/0/0		Autumn		I
	Introduction to Geology	5	60/65 2/2/0/0		Autumn		I

Compulsory courses / modules of specialty (specialization)							
	Name of the course / module	**ECTS**	**Contact/ independent work hours lecture / practice / seminar / laboratory**	**Requirements for admission to the course / module**	**Semesters of the study (Autumn / Spring)**	**Lecturer / Lecturers**	**Recommended Semester**
	Basics of Programming	5	75/50 2/2/0/1		Autumn		I
	Linear Algebra and Analytical Geometry	5	60/65 2/2/0/0		Autumn		I
	Algorithms and Data Structures	10	90/160 3/2/0/1	Basics of Programming	Spring		II
	Object Oriented Programming 1 (C ++)	10	90/160 2/2/0/2	Basics of Programming	Spring		II
	Calculus for Computer Science	5	45/80 1/2/0/0	1. Calculus 2. Linear Algebra and Analytical Geometry	Spring		II
	Discrete structures	5	60/65 1/2/1/0	Linear Algebra and Analytical Geometry	Autumn		III
	Numerical Methods: Design, Analysis and Computer Implementation of Algorithms	5	60/65 1/1/1/1	1. Calculus 2. Linear Algebra and Analytical Geometry 3. Basics of Programming	Autumn		III
	Design of Algorithms	5	45/80 1/1/1/0	Algorithms and Data Structures	Autumn		III
	Object Oriented Programming 2 (Java, C#, VBA)	5	45/80 2/0/0/1- Java 1/0/0/2 - C# 1/1/0/1 - VBA	1. Object Oriented Programming 1 (C ++) 2. Foreign Language 2 (English) for Java	Autumn / Spring		III, IV, V, VI
	Mathematical Programming	5	45/80 1/2/0/0	Calculus for Computer Science	Spring		IV
	Data Base	5	60/65 1/0/1/2	1. Basics of Programming 2. Object Oriented Programming 1	Spring		IV

				3. Computer skills and IT			
	Data Analysis and Statistics	5	60/65 1/0/2/1	Calculus for Computer Science	Spring		IV
	Operations Research	5	45/80 1/1/0/1	Mathematical Programming	Autumn		V
	Operating systems	5	45/80 1/0/1/1	Object Oriented Programming 1 (C ++)	Autumn		V
	Modeling and Simulation	5	60/65 1/0/2/1	Data Analysis and Statistics	Autumn		V
	Intelligence systems	5	45/80 1/0/1/1	1. Object Oriented Programming 1 2. Design of Algorithms	Autumn		VI
	Network Technologies and Communications	5	45/80 1/0/0/2	Operating systems	Autumn		VI
	Software Engineering	5	30/95 1/0/1/0	1. Design of Algorithms 2. Object Oriented Programming 2	Autumn		VII
	Computer Architecture and Organization	5	45/80 1/0/1/1	1. Basics of Programming 2. Object Oriented Programming 1 3. Computer skills and IT 4. Operating systems	Autumn		VII
Elective courses / modules of specialty (specialization)							
	Name of the course / module	**ECTS**	**Contact/ independent work hours lecture / practice / seminar / laboratory**	**Requirements for admission to the course / module**	**Semesters of the study (Autumn / Spring)**	**Lecturer / Lecturers**	**Recommended Semester**
Theoretical Informatics							
	Elements of Computer Algebra	5	30/95 1/1/0/0	1. Calculus 2. Linear Algebra and Analytical Geometry 3. Basics of Programming 4. Algorithms and Data Structures	Autumn / Spring		IV-VIII
	Algorithmic Information Theory	5	30/95	1. Basics of Programming	Autumn /		IV-VIII

			1/1/0/0	2. Algorithms and Data Structures	Spring		
	Algorithms for Computational Topology	5	30/95 1/1/0/0	1. Basics of Programming 2. Algorithms and Data Structures	Autumn / Spring		IV-VIII
	Combinatorial Optimization	5	45/80 1/0/1/1	Operations Research	Autumn / Spring		VI-VIII
	Introduction to Complexity Theory	5	30/95 1/1/0/0	1. Basics of Programming 2. Algorithms and Data Structures	Autumn / Spring		IV-VIII
	Information Retrieval	5	30/95 1/1/0/0	1. Basics of Programming 2. Calculus	Autumn / Spring		IV-VIII
Practical Informatics							
	Mathematical computer system MATLAB	5	45/80 1/0/0/2	1. Computer skills and IT 2. Calculus	Autumn / Spring		III-VIII
	"Mathematica 7" and its capabilities	5	45/80 1/0/0/2	1. Computer skills and IT 2. Calculus	Autumn / Spring		III-VIII
	Functional Programming using Haskell	5	45/80 1/0/0/2	Basics of Programming (anti - condition – Advances in Discrete Structures: the programming language Haskell)	Autumn / Spring		III-VIII
	ADO.NET technology - data access from NET application	5	30/95 1/0/0/1	1. Object Oriented Programming 2 (C#) > 65 point	Autumn / Spring		III-VIII
	ASP.NET technology – creating of WEB - applications	5	30/95 1/0/0/1	1. Object Oriented Programming 2 (C#) > 65 point	Autumn / Spring		III-VIII
	Advanced course of Algorithms	10	45/205	1. Object Oriented	Autumn /		III-VIII

			1/0/0/2	Programming 1(C++) 2. Algorithms and Data Structures	Spring		
	Implementations of Algorithms and Data Structures	5	45/80 1/0/0/2	1. Object Oriented Programming 1 (C++) (> 70 point) 2. Algorithms and Data Structures (> 70 point)	Autumn / Spring		III-VIII
	Programming with Java (Advanced Course)	5	45/80 2/0/0/1	1. Object Oriented Programming 2 (Java) > 60 point 2. English (10 ECT) 3. Data Base	Autumn / Spring		III-VIII
Applied Informatics							
	Information Management	5	45/80 2/0/1/0	Computer skills and IT	Autumn / Spring		
	Formal language and Endless Automats	5	45/80 1/2/0/0	Discrete structures	Autumn / Spring		III-VIII
	Genetic Algorithms	5	45/80 1/0/1/1	Design of Algorithms	Autumn / Spring		III-VIII
	Neural Networks	5	45/80 1/0/1/1	Discrete structures	Autumn / Spring		III-VIII
	Behavioral models of discrete systems	5	45/80 1/2/0/0	Discrete structures	Autumn / Spring		IV-VIII
	The Technologies of The information Security	5	45/80 1/1/1/0	1. Discrete structures 2. Design of Algorithms	Autumn / Spring		III-VIII
	Cryptographic Algorithms	5	45/80 1/1/1/0	Discrete structures	Autumn / Spring		III-VIII
	Information Theory and Coding	5	45/80 1/1/1/0	Discrete structures	Autumn / Spring		III-VIII
	Information Models and Systems-1	5	45/80 1/2/0/0	Algorithms and Data Structures	Autumn / Spring		III-VIII
	Information Models and Systems-2	5	45/80 1/0/0/2	Algorithms and Data Structures	Autumn / Spring		III-VIII

Technical Informatics							
	Network Technologies and Communications 2	5	45/80 1/0/0/2	Network Technologies and Communications	Autumn / Spring		V-VIII
	Operating System Linux for Servers	5	45/80 1/0/0/2	1. Operating systems 2. Network Technologies and Communications	Autumn / Spring		V-VIII
	Quantum Informatics	5	45/80 1/0/2/0	1. Algorithms and Data Structures 2. Discrete structures	Autumn / Spring		V-VIII
	WEB Design	5	45/80 1/0/0/2	1. Computer skills and IT 2. Basics of Programming	Autumn / Spring		III-VIII
	Fundamentals of programming of dynamic WEB-pages	5	45/80 1/0/0/2	WEB Design	Autumn / Spring		IV-VIII
	Data Description and Analysis with Spreadsheets	5	45/80 1/0/0/2	1. Computer skills and IT 2. Basics of Programming	Autumn / Spring		III-VIII
	Creating and Managing Projects with Microsoft Project	5	45/80 1/0/0/2	1. Computer skills and IT 2. Basics of Programming	Autumn / Spring		III-VIII
	Operating systems installation and management of the user element	5	45/80 1/0/0/2	Computer skills and IT	Autumn / Spring		III-VIII
	MS Office	5	45/80 1/0/0/2	Computer skills and IT	Autumn / Spring		III-VIII
	e-Learning instruments in Education process	5	45/80 1/0/0/2	Computer skills and IT	Autumn / Spring		III-VIII
	Developing technologies of Knowledge bases	5	45/80 1/0/2/0	Data Base	Autumn / Spring		III-VIII
	Operating system for mobile devices	5	45/80 1/0/1/1	Object Oriented Programming 2 (Java)	Autumn / Spring		V-VIII
	Sensory Computer Systems	5	45/80 1/0/0/2	Computer skills and IT	Autumn / Spring		IV-VIII
	Software tools in Science and Business	5	45/80 1/0/0/2	Computer skills and IT	Autumn / Spring		IV-VIII
	Database Web Design	5	45/80	1. Data Base	Autumn /		IV-VIII

			1/0/0/2	2. WEB Design	Spring		
The block of Mathematical Logic and Discrete Structures							
	Advances in Discrete Structures: the programming language Haskell	5	45/80 1/0/0/2	1. Discrete structures 2. Basics of Programming (anti - condition – Functional Programming using Haskell)	Autumn / Spring		III-VIII
	Computer Implementation of Discrete Structure Problems	5	45/80 1/0/0/2	Calculus	Autumn / Spring		III-VIII
	Fuzzy logic with applications	5	45/80 1/2/0/0	Discrete structures	Autumn / Spring		III-VIII
The block of Numerical Analysis and Computing Technologies							
	Modeling with Ordinary Differential Equations (Project)	5	30/95 1/0/1/0	Numerical Methods: Design, Analysis and Computer Implementation of Algorithms	Autumn / Spring		IV-VIII
	Modeling with Partial Differential Equations (Project)	5	30/95 0/0/1/1	Numerical Methods: Design, Analysis and Computer Implementation of Algorithms	Autumn / Spring		IV-VIII
	Mathematical modeling technologies	5	45/80 1/0/1/1	Numerical Methods: Design, Analysis and Computer Implementation of Algorithms	Autumn / Spring		IV-VIII
Research-oriented block							
	Group Project or Bachelor's thesis	10	30/220 1/0/1/0	Software Engineering	Spring		VIII

Tbilisi State University

Faculty of Exact and Natural Sciences

Department of Electrical and Electronics Engineering

BSc Program

"Electronics"

Bachelor of Science in Electrical and Electronics Engineering

ECTS: 240

Min Duration: 8 semesters

SHORT DESCRIPTION:

- **Systemic View on discipline.** Students should get general systemic idea about electrical and electroncis engineering, as of an applied science direction, which is based on theoretic and experimental fundamentals of natural sciences. Electrical and electronics engineering uses such knowledge and improves it via application to electronics technologies.
- **Deep knowledge of basics of electrical and electronics engineering and application of this knowledge to practice.** Students should know theoretical foundations of electrical and electronics engineering. Based on such knowledge they should be able to solve appropriate engineering problems.
- **Knowledge of state-of-the-art of measurement and theoretic (computer simulation based) technologies.** Technologies, approaches and methods of electrical and electronics engineering are widely used in nowadays society. Examples are: different types of vehicles, aero-cosmic and military apparatus, measurement devices, bio-mdical hardware, control of chemical processes, etc. Bachelor of science in electrical and electronics engineering should be able to understand a principal schematic of electronics products. He/she should be able to generalize data and knowledge, should be able to apply fundamentals to the solution of particular engineering problem.
- **Skills of working in group projects.** Electrical and electronics engineering is very fast expanding and dynamic discipline. Most of the projects imply that individual approaches are not so efficient as group projects. Bachelor should have skills to work in a group in order to be efficient. He/she should be able to understand a complete picture, while working on fragments of the project.
- **Knowledge and skills, necessary for professional growth.** Aim of the program is to educate a person, able to find a job in electrical and electronics engineering disciplines, but also he should get very solid set of skills to rise his/her professional knowledge.
- **General/transfer skills.** Bachelor should be able to choose efficient methods of solution of stated engineering problem, to identify necessary set of measurement or computer resources and finally solve a problem. He/she should be able to analyze gained results and communicate them to others.

CURRICULUM

#	Course	ECTS	hh per week	Lecture/Practice/ Lab/seminar	Contact hh/ independent hh	Course prerequisites	Semester							
							I	II	III	IV	V	VI	VII	VIII
University Studies (ECTS 20)														
1	უცხო ენა 1: (ინგლისური) Language 1 (English)	5	4		60/65			5						
2	უცხო ენა 2: (ინგლისური) Language 2 (English)	5	4		60/65				5					
3	კალკულუსი Calculus	5	4	2/2/0/0	60/65		5							
4	კომპიუტერული უნარ-ჩვევები Computer Skills	5	2	0/0/0/2	30/95		5							
Faculty Studies (ECTS 5+5+5+5=20)														
5	წრფივი ალგებრა და ანალიზური გეომეტრია Linear Algebra and Analytic Geometry	5	4	2/2/0/0	60/65		5							
6 (EEE)	ელექტრონიკის შესავალი Introduction into Electronics		4	2/2/0/0	60/65		5							
7	დაპროგრამების საფუძვლები Basics of Programming		4	2/2/0/0	60/65		5							
8	ფიზიკის შესავალი Introduction into Physics		4	2/2/0/0	60/65		5							
9	გეოგრაფიის შესავალი Introduction into Geography		4	2/2/0/0	60/65		5							
10	ბიოლოგიის შესავალი Introduction into Biology		4	2/2/0/0	60/65		5							

11	ქიმიის შესავალი Introduction into Chemistry	5	4	2/2/0/0	60/65		5							
12	გეოლოგიის შესავალი Introduction into Geology	5	4	2/2/0/0	60/65		5							
Major Credits (ECTS 130)														
MATH1	მათემატიკა ელექტრონიკისათვის: მათ-ანალიზი Mathematics for Electronics: Mathematical Analysis	5	4	2/2/0/0	60/65	3		5						
MATH2	მათემატიკა ელექტრონიკისათვის: ვექტორული და ტენზორული ანალიზი, დიფ. გეომეტრიის ელემენტები Mathematics for Electronics: Vector and Tenzor Analysis, Elements of Differential Geometry	5	4	2/2/0/0	60/65	3		5						
MATH3	მათემატიკა ელექტრონიკისათვის: კომპლექსური ანალიზი, ფურიეს ანალიზი Mathematics for Electronics: Complex Analysis, Fourier Analysis	5	4	2/2/0/0	60/65	3			5					
MATH4	მათემატიკა ელექტრონიკისათვის: დიფ-განტოლებები Mathematics for Electronics: Differntial Equations	5	4	2/2/0/0	60/65	MATH1			5					
MATH5	მათემატიკა ელექტრონიკისათვის: ალბათობა და სტატისტიკა Mathematics for Electronics: Probability and Statistics	5	4	2/2/0/0	60/65	3				5				
MATH6	მათემატიკა ელექტრონიკისათვის: რიცხვითი მეთოდები I Mathematics for Electronics: Numerical Methods I	5	4	2/2/0/0	60/65	MATH1				5				
MATH7	მათემატიკა ელექტრონიკისათვის: რიცხვითი მეთოდები II Mathematics for Electronics: Numerical Methods II	5	4	2/2/0/0	60/65	MATH6					5			
PHYS1	გამოყენებითი ფიზიკა: მექანიკა და მოლეკულური ფიზიკა Applied Physics: Mechanics and Molecular Physics	5	4	2/2/2/0	60/65	3,8		5						
PHYS2	გამოყენებითი ფიზიკა: ელექტრომაგნეტიზმი Applied Physics: Electricity and Magnetism	5	4	2/2/2/0	60/65	PHYS1			5					
PHYS3	გამოყენებითი ფიზიკა: ოპტიკა Applied Physics: Optics	5	4	2/2/2/0	60/65	3,8				5				
PHYS4	გამოყენებითი ფიზიკა: ატომური ფიზიკა Applied Physics: Atom Physics	5	4	2/2/2/0	60/65	PHYS1					5			

COMP1	საინჟინრო/კვლევითი ამოცანების ამოხსნა მატლაბში Engineering Problem Solving in Matlab	5	4	1/1/2/0	60/65	3		5						
COMP2	დაპროგრამების ენა C++ ან დაპროგრამების ენა C Programming in C++ / Programming in C	5	8	1/1/2/0	60/65	7			5					
EEE1	ელექტრული წრედები Electrical Circuits	5	4	2/2/0/0	60/65	3, 6 (EEE)		5						
EEE2	ელექტრონიკა Electronics	5	4	1/1/2/0	60/65	6 (EEE)			5					
EEE3	ციფრული სისტემები Digital Systems	5	4	1/1/2/0	60/65	EEE2				5				
EEE4	წრფივი სისტემები და სიგნალების თეორია Linear Systems and Signal Theory	5	4	2/2/0/0	60/65	MATH3, MATH4, EEE1				5				
EEE5	ლაბორატორიული კურსი: გამოყენებითი ელექტრონიკა Lab: Applied Electronics	5	4	0/0/3/1	60/65	EEE2				5				
EEE6	ლაბორატორიული კურსი: ელექტრონული ხელსაწყოები და სენსორული სისტემები Lab: Electrical Devices and Sensor Systems	5	4	0/0/3/1	60/65	EEE3					5			
EEE7	ნახევარგამტარების ფიზიკა Semiconductor Physics	5	4	2/0/2/0	60/65	PHYS2, PHYS4						5		
EEE8	საკურსო: ელექტრონული ხელსაწყოების პროექტირება Project: Design of Electrical Devices	5	4	0/0/3/1	60/65	EEE5							5	
EEE9	გამოყენებითი ელექტროდინამიკა Applied Electrodynamics	5	4	2/0/0/2	60/65	PHYS1, MATH2,MATH3, MATH4					5			
EEE10	ანტენები და ელექტრომაგნიტური ტალღების გავრცელება Antennas and Wave Propagation	5	4	1/1/2/0	60/65	EEE9						5		
EEE11	ელექტრომაგნიტური თავსებადობის საფუძვლები Basics of Electromagnetic Compatibility	5	4	1/1/2/0	60/65	PHYS2, EEE1							5	
EEE12	ენერგეტიკული სისტემები I Power Systems I	5	4	2/2/0/0	60/65	PHYS2						5		
EEE13	ენერგეტიკული სისტემები II Power Systems II	5	4	2/2/0/0	60/65	PHYS2							5	

Non-Major Credits (ECTS 50)															
EEE14	მეტროლოგია Metrology	5	4	2/0/2/0	60/65	6 (EEE)									
EEE15	მიკროპროცესორები და მათი დაპროგრამების საფუძვლები Microprocessors and Basics of their Programming	5	4	1/1/2/0	60/65	7/COMP2, EEE3									
EEE16	ლაბორატორიული კურსი: მოწყობილობების კომპიუტერული მართვა Lab: Device Control	5	4	0/0/4/0	60/65	7/COMP2, EEE3									
EEE17	ბიოსამედიცინო კვლევითი ელექტრონული აპარატურა Biomedical Electronic Equipment	5	4	2/0/2/0	60/65	PHYS2, EEE2									
EEE18	ლაბორატორიული კურსი: კომპიუტერული ბიო-მოდელირება და ვიზუალიზაცია Lab:Bio-computing and Visualization	5	4	0/0/4/0	60/65	COMP1 or MATLAB, MATH4 or equivalent									
EEE19	გამოყენებითი გეოფიზიკის საფუძვლები Basics of Applied Geophysics	5	4	2/0/2/0	60/65	MATH1 or equivalent									
EEE20	დისტანციური ზონდირება გეოფიზიკაში Remote sensing in Geophysics	5	4	2/2/0/0	60/65	EEE19									
EEE21	ენერგიის გარდაქმნა და ენერგიის ალტერნატიული წყაროები Energy conversion and alternative source of energy	5	4	1/1/1/1	60/65	6 (EEE) / 8									
EEE22	პროექტი: ელექტრონული ხელსაწყოები გეოფიზიკაში და კოსმოფიზიკაში Project: Measurement Devices in Geophysics and Cosmophysics	5	4	0/0/4/0	60/65	EEE19									
EEE23	საბაკალავრო ნაშრომი Bachelor Diploma Thesis	10	4	0/0/4/0	60/190										

Responsible for the program: Prof. Roman Jobava (roman.jobava@tsu.ge)

Appendix 7 - Ilia State University Microelectronics and Computer Engineering Curriculum

Faculty	*School of Engineering*
Program Title	*Microelectronics and Computer Engineering* *(Informatics; Microelectronics)*
Academic Degree Acquired	Bachelor of Engineering in Informatics; Bachelor of Engineering;
Program Duration	*8 Semesters – 240 ECTS** *Major – 120 ECTS* *General module – 60 ECTS;* *Minor/Free Electives – 60 ECTS;* ** 1 ECTS – 25 hours.*
Language of Instruction	*Georgian*

Admissions Requirements

Prospective students are required to pass the Unified National Exams by scoring at the benchmark level or higher on the General Aptitude, Georgian Language, English Language, and Mathematics tests (4 exams).

Purpose & Objectives of the Program

The purpose of the Bachelor degree program in Microelectronics and Computer Engineering is to well equip students with broad and up-to-date scientific and technological knowledge and multi-skills in computer technology and microelectronics. This specialization is based on multidisciplinary teaching in different areas.

In the field of informatics, the objective of the program is to provide students with knowledge background and hands-on experience in computer and software engineering, application of its principles, methods and tools, which include: computer systems building and management methods; network organization and management methods; software engineering methods and tools, an algorithmic problem solving and computer software marketing. The undergraduate program is geared towards providing quality instruction for students to acquire solid knowledge in algorithm theory, variety of programming languages, object-oriented programming, programming technologies, web programming, database management, computer networks, and administration of several operating systems, electronics, numerical analysis and statistics.

In the field of microelectronics, the aim of the program is to provide students with knowledge background and hand-on practice in microelectronics engineering. Specifically, it aims at enhancing students' knowledge and skills in relevant methods and tools application, technical problem solving in microelectronics engineering and developing their skills in electronic equipment building from idea to prototype. Respectively, the program includes disciplines which develop students' fundamental knowledge in algorithm theory, object-oriented programming, creation of electronic circuits, electronic boards design, digital signal processing, microprocessors architecture and their programming, programmable logics and their programming, computer control of microelectronic devices, electric components and their working principles, connecting sensors to microprocessors, construction of robots and monitoring/measuring devices, different issues of numerical analysis.

In line with its purpose, the program aims at preparing students for their successful professional career. Along with the field-specific knowledge and experience in informatics and microelectronics, it is designed to help students build their critical thinking skills and develop into effective decision-makers promoting liberal values and principles. Importantly, the program targets students' communication skills through improving their foreign (English) language skills and presentation skills.

Finally, the program serves as a start-up for students' further studies of their choice in the fields of computer

engineering and microelectronics.

Learning outcomes and competencies (General and field-specific)

1. Field-Specific Knowledge and Awareness:

Informatics:

The program graduates will have broad theoretical knowledge in computer systems architecture, the principles of various system software applications, communication network planning and development and network security. They will also be introduced to the principles of networking and acquire basic knowledge in electronics. Program graduates will be given an opportunity to acquire knowledge and skills based on recent achievements in programming engineering that will be enhanced by hands-on experience. Graduates will have effective problem solving skills that will help them in their software development tasks.

Microelectronics:

The program graduates will obtain broad theoretical knowledge that is based on recent achievements in the area of microelectronics engineering that is enhanced by practical experience in the up-to-date laboratory facility. Under supervision they will be able to participate in the development of electronic devices and develop and complete technical tasks. Importantly, program graduates will know new technologies in microelectronics and acquire practical skills in their application.

2. Knowledge Application:

Informatics:

By the end of the program, students will be able to:

- Use several operational systems, appropriate software packages on different computer hardware;
- Design and develop computer networks projects, build and configure them by applying theoretical knowledge in practice;
- Develop and provide solutions to different task algorithms and solve procedures using the strict logical justification;
- Use modern programming technologies and pre-defined instructions, create an appropriate algorithm for a particular task and make computer software;
- Develop database structure, database and web interface for end-users;
- Participate in development and implementation of software for in order to create technical task;
- Develop a numerical scheme for different tasks in physics, mathematics and chemistry.

Microelectronics:

By the end of the program, students will:

- Be able to technically realize different tasks based on theoretical knowledge and develop electronic devices;
- Develop and provide solutions to different task algorithms and solves procedures using the strict logical justification;
- Apply modern technologies of Microelectronics and under supervision develop electronic devices and necessary software for their control;
- Take part in development and implementation of software in order to create technical task.

3. Critical Thinking Skills:

Program graduates will:

- Have effective problem solving skills;
- Be able to conduct information analysis and synthesis;
- Be able to give well-grounded arguments and draw logical conclusion based on available data and information.

4. Communication skills:

Program graduates will:

- Be able to communicate on field specific topics in Georgian and English with professional or non-professional audience
- Be able to effectively master professional information;
- Be able to develop detailed written reports and solutions relevant to Microelectronics, Informatics and Computing;
- Be able to present software as the end-results of their professional performance;
- Be able to effectively and purposefully use modern communication technologies.

5. Learning skills

Program Graduates will:

- Be able to independently acquire knowledge and further develop their professional skills in the area of their choice. Critical thinking skills developed and knowledge acquired within the framework of the undergraduate program will allow students to further pursue their graduate studies in relevant fields;
- Be able to process new literature in the field of Information Technologies. They will be able to use modern resources for information research and independently master new field-specific knowledge.

6. Values

- During their studies, students will develop professional values and become aware of professional ethical requirements. The latter will specifically concern cases of information storage and processing as a result of their professional performance.
- The program graduates will be able to work in teams and effectively run projects with pre-defined practical recommendations and instructions.
- Program graduates will be able to participate in establishment of liberal values that will be implanted in their professional performance.

Program Structure

Bachelor degree Program in Microelectronics and Computer Engineering consists of:
General module – 60 Credits;
Major Program – 120 Credits;
Minor Program/Free elective courses – 60 Credits;

Microelectronics and Computer Engineering undergraduate program has 4 modules:

1. Introduction to the course module
2. Common module
3. Informatics module
4. Microelectronics module

In the first year of their studies students are required to take General module coded INTRO subjects and 4 introduction subjects proposed by the School of Engineering including 2 required courses from the module of Microelectronics and Computer Engineering program which will be considered as the selected direction credits (3 credits each).
In the beginning of second year student selects its direction by choosing the mandatory and elective courses of specific direction.
The student of Microelectronics and Computer Engineering program is obliged to collect:

Requirements for Major Program

1. From the University General intro courses – 6 credits
2. From the Introductory course modules of School of Engineering with code CEM-INTRO-EL CO – 6 credits
3. From the Main General module of Microelectronics and Computer Engineering program, core courses with codes **CEMGEN** – 24 Credits, and from elective courses with codes **0/CEM** - 54 Credits, total 78;

1. **For the students of Informatics**:

a) From the informatics module main courses with code **CEMITGEN** – 6 Credits;
b) b) Courses with code **0/CEMIT** – 24 Credits

2. **For the students of Microelectronics**:

a) Core courses with code **CEMMLGEN** from the Microelectronics module – 18 Credits
b) Courses with code **CEMML** – 12 Credits
3. Elective courses from other programs – (to fill 120credits) – 6 credits

Requirements for Minor Program

From the Main General module of Microelectronics and Computer Engineering program:

1. Core courses with codes **CEMGEN** – 24 Credits,
2. From the Informatics module core courses with code **CEMITGEN** – 6 Credits;
3. From elective courses with code **0/CEM** or**0/CEMIT** – 30 Credits

Teaching Methods

- Lectures
- Seminars
- Colloquium
- Presentations
- Independent work
- Group work
- Lab works
- Practical Works

Evaluation rules

Evaluation rule (100 points)

(A) 91 - 100 excellent
(B) 81 - 90 very good
(C) 71 - 80 Good
(D) 61 - 70 Satisfactory
(E) 51 - 60 Sufficient
(FX) 41 - 50 not passed, a student can sit the final exam once again;
(F) 0 - 40 failed, a student is required to take the course again

Employment Perspectives

Bachelor of the Microelectronics and Computer Engineering qualifies for employment if he/she has completed the following fields:

1. Informatics

- Scientific-research institutions, which specialize in research of software engineering, information security and protection methods, as well as in those institutions that require specific programs and applications for their activities.
- Companies that specialize in commercial software development, modification and/or implementation;

- Companies that specialize in computer equipment installation and hardware or software services
- Companies that specialize in the design and installation of computer networks;
- Companies that intensively create and use their own programs and systems, including: banking, industrial, retail institutions, governmental or non-governmental organizations.

2. Microelectronics

- Companies that specialize in computer software and electronics hardware manufacturing and support;
- Any company that works on creation and support of the hardware and devices needed for themselves.

Necessary support conditions/resources for learning

- Computer Information Center
- Lecture classrooms
- Study Labs
- University Library
- Student's Registration and Learning Process Network
- Academic Advisor

	Courses		Mand/Elect.	Credits	Contact Hours	Prerequisites	F	S
	GENERAL MODULE (taught at first year at the School of Engineering)							
	GENERAL COURSES							
1	Introduction to Modern Thought I		Man.	6	3		x	
2	Introduction to Modern Thought II		Man.	6	3			x
3	Calculus 1		Man.	6	3		x	
4	Calculus 2		Man.	6	3			x
5	Computer processing of visual information I		Man.	6	3		x	
6	Computer processing of visual information II		Man.	6	3			x
7	English Language Practical Course (Starter)		Man/Elect	6	9		x	x
8	English Language Practical Course (Elementary)		Man/Elect	6	9		x	x
9	English Language Practical Course (Pre-Intermediate)		Man/Elect	6	9		x	x
10	English Language Practical Course (Intermediate 1)		Man/Elect	6	9		x	x
11	English Language Practical Course (Intermediate 2)		Man/Elect	6	9		x	x
12	English Language Practical Course (Upper Intermediate 1)		Man/Elect	6	9		x	x
13	English Language Practical Course (Upper Intermediate 2)		Man/Elect	6	9		x	x
14	English Language Practical Course (Advanced 1)		Man/Elect	6	9		x	x
15	English Language Practical Course (Advanced 2)		Man/Elect	6	9		x	x
	Introductory Module of School of Engineering							
1	Planetary Geophysics		INTRO	3	33		x	x
2	Origin and Evolution of the Universe		INTRO	3	33		x	x
3	Historical Earthquakes (Archaeo Seismology)		INTRO	3	32		x	x
4	Earth's structure and Theory of Plate Tectonics		INTRO	3	34		x	x
5	Volcanoes, caves, waterfalls of Georgia		INTRO	3	33		x	x
6	Geological and Paleontological Basis of Evolution Theory		INTRO	3	33		x	x
7	Vital Resources of Modern Civilization of Earth		INTRO	3	33		x	x
8	Introduction to Geo-information Systems		INTRO	3	32		x	x
9	Earth Sciences		INTRO	3	32		x	x
10	History of Earth		INTRO	3	32		x	x
11	Introduction to Architecture		INTRO	3	68		x	
12	Introductory Course to Architecture (Composition, Idea, Form)		INTRO	3	45			x
13	Introduction to Design		INTRO	3	68			x
14	Space and Time as Viewed by Modern Physics		INTRO	3	32		x	
15	Solved and Unsolved Mysteries of Science		INTRO	3	32		x	
16	Elementary Particles and Forces of Nature		INTRO	3	32		x	x
17	Cosmology –Theory of the origin and evolution of the world		INTRO	3	32		x	x
18	From Zoroastrianism to Artificial Intelligence		INTRO	3	32		x	
19	Physics of Micro world - Basics of quantum physics		INTRO	3	32			x
20	Contemporary Physics in Modern Technologies		INTRO	3	32			x
21	Biophysics and Biotechnology		INTRO	3	32			x
22	The Role of Nature's Laws in Our Life		INTRO	3	32			x
23	The Mysteries of Micro and Macro world		INTRO	3	32			x
	(CEM-INTRO)Introductory Courses to Electronics and Computer Engineering							
1	Introduction to Microelectronics and Robotics		CEMINTRO	3	33		x	x
2	Introduction to Information Technologies		CEMINTRO	3	34		x	x
3	Introduction to Software Development		CEMINTRO	3	37		x	x

	CEM (general courses for Microelectronics and Computer Engineering)							
1	Structural Programming	CEMGEN	Man.	6	64		x	x
2	Object-Oriented Programming	0/CEM	Man/elect	6	48	Structural Programming	x	x
3	Algorithm Theory	0/CEM	Man/elect	6	48	Structural Programming	x	x
4	Data Structures	0/CEM	Man/elect	6	48	Algorithm Theory		x
5	System Programming	0/CEM	Man/elect	6	48	Structural Programming		x
6	Calculus 3	0/CEM	Man/elect	6	48		x	
7	Calculus 4	0/CEM	Man/elect	6	48	Calculus 3		x
8	Software Engineering	0/CEM	Man/elect	6	48	High Technology Programming	x	
9	Personal computer architecture	CEMGEN	Man.	6	66			x
10	Architecture of Servers and Peripherals	0/CEM	Man/elect	6	48		x	
11	Operating Systems 1(Windows, Windows Server)	0/CEM	Man/elect	6	48			x
12	Operating Systems 2 (Linux)	0/CEM	Man/elect	6	48			
13	High Technology Programming	0/CEM	Man/elect	6	48	Object-Oriented Programming	x	x
14	Numerical Methods	0/CEM	Man/elect	6	48	Structural Programming, Calculus	x	
15	Databases and their Management Systems	CEMGEN	Man.	6	48			x
16	Basics of Physics I	0/CEM	Man/elect	6	32		x	
17	Basics of Physics II	0/CEM	Man/elect	6	32			x
18	Programming for multilevel applications	0/CEM	Man/elect	6	48	High Tech. Programming, Databases and their Management Systems	x	
19	Programming in Scripting Operating Systems	0/CEM	Man/elect	6	48	Structural Programming		x
20	Programming for mobile devices	0/CEM	Man/elect	6	48		x	
21	MATLAB 1	0/CEM	Man/elect	6	48		x	
22	MATLAB 2	0/CEM	Man/elect	6	48			x
23	Artificial Intelligence	0/CEM	Man/elect	6	48	Data Structures, High Tech. Programming		x
24	Bachelor's Thesis	CEMGEN	Man.	6	48			x
	(CEMIT) Informatics Module							
1	Computer System Software	0/CEMIT	Man/elect	6	52			x
2	Hardware-Oriented Programming	0/CEMIT	Man/elect	6	48		x	
3	Computer Networks	CEMIT	Man.	6	64		x	
4	Probability and Mathematical Statistics	0/CEMIT	Man/elect	6	48	Calculus		x
5	Web - Programming	0/CEMIT	Man/elect	6	48	Object-Oriented Progr. / Databases and their Management Systems	x	
6	Constructing Network Servers Using Operating Systems	0/CEMIT	Man/elect	6	48	Operating Systems 1	x	
7	Computer Networks II	0/CEMIT	Man/elect	6	48			x
8	Computer Virology	0/CEMIT	Man/elect	6	48		x	
9	Cyber Security	0/CEMIT	Man/elect	6	48			x
10	Basics of Computer Graphics Programming	0/CEMIT	Man/elect	6	48		x	
	(CEMML) Microelectronics module							
1	Basics of Electronics	0/CEMML	Man/elect	6	64		x	
2	Introduction to JAVA	0/CEMML	Man/elect	6	64		x	
3	Low-bit Architecture Microprocessors and Programming. The first step in Robotics	CEMML	Man.	6	94		x	
4	Sensors - connection between the environment and electronics, electronics and information management computer display.	CEMML	Man.	6	94	Low-bit architecture microprocessors and programming. The first step in robotics		x
5	Schemes and designing electronic boards. Electronic equipment from idea to prototype	CEMML	Man/elect	6	68		X	
6	FPGA	0/CEMML	Man/elect	6	94			x
7	Linux-based Microcomputer Architecture and	0/CEMML	Man/elect	6	94	Sensors - connection		x

	Programming. Electronic equipment, from idea to prototype					between the environment and electronics, electronics and information management computer display.		

Map of learning results

Learning Courses/Modules	List of competencies					
	Knowledge and Understanding	Ability to apply knowledge in practice	Conclusion skills	Communication skills	Learning skills	Values
General Module						
Introduction to Modern Thought I	x	x	x	x	x	x
Introduction to Modern Thought II	x	x	x	x	x	x
Calculus 1	x	x	x	x	x	x
Calculus 2	x	x	x	x	x	x
Computer processing of visual information I	x	x	x	x	x	x
Computer processing of visual information II	x	x	x	x	x	x
English Language Practical Course (Starter)	x	x	x	x	x	x
English Language Practical Course (Elementary)	x	x	x	x	x	x
English Language Practical Course (Pre-Intermediate)	x	x	x	x	x	x
English Language Practical Course (Intermediate 1)	x	x	x	x	x	x
English Language Practical Course (Intermediate 2)	x	x	x	x	x	x
English Language Practical Course (Upper Intermediate 1)	x	x	x	x	x	x
English Language Practical Course (Upper Intermediate 2)	x	x	x	x	x	x
English Language Practical Course (Advanced 1)	x	x	x	x	x	x
Introductory Module of School of Engineering						
Planetary Geophysics	x	x	x	x	x	
Origin and Evolution of the Universe	x		x	x	x	
Historical Earthquakes (ArchaeoSeismology)	x	x	x	x	x	x
Earth's structure and Theory of Plate Tectonics	x	x	x	x	x	x
Volcanoes, caves, waterfalls of Georgia	x	x	x	x	x	
Geological and Paleontological Basis of Evolution Theory	x		x	x	x	x
Vital Resources of Modern Civilization of Earth	x	x	x	x	x	
Introduction to Geo-information Systems	x	x	x	x	x	
Earth Sciences	x	x	x	x	x	x
History of Earth	x	x	x	x	x	x
Introduction to Architecture	x	x	x	x	x	x
Introductory Course to Architecture (Composition, Idea, Form)	x	x	x	x	x	x
Introduction to Design	x	x	x	x	x	x
Space and Time as Viewed by Modern Physics	x	x	x	x	x	x
Solved and Unsolved Mysteries of Science	x	x	x	x	x	x
Elementary Particles and Forces of Nature	x	x	x	x	x	x
Cosmology –Theory of the origin and evolution of the world	x	x	x	x	x	x
From Zoroastrianism to Artificial Intelligence	x	x	x	x	x	x

Physics of Micro world - Basics of quantum physics	x	x	x	x	x	x
Contemporary Physics in Modern Technologies	x	x	x	x	x	x
Biophysics and Biotechnology	x	x	x	x	x	x
The Role of Nature's Laws in Our Life	x	x	x	x	x	x
The Mysteries of Micro and Macro world	x	x	x	x	x	x
Introductory Courses to Computer Engineering and Microelectronics						
Introduction to Microelectronics and Robotics	x	x	x	x	x	x
Introduction to Information Technologies	x	x	x	x		x
Introduction to Software Development	x	x	x	x	x	x
General module						
Structural Programming	x	x	x		x	x
Object-Oriented Programming	x	x	x		x	x
Algorithm Theory	x	x	x	x	x	x
Data Structures	x	x	x	x	x	
System Programming	x	x	x		x	x
Calculus 3	x	x		x	x	x
Calculus 4	x	x		x	x	x
Software Engineering	x	x	x	x	x	x
Personal computer architecture	x	x	x	x		x
Architecture of Servers and Peripherals	x	x	x	x		x
Operating Systems 1 (Windows, Windows Server)	x	x	x	x		x
Operating Systems 2 (Linux)	x	x	x	x		x
High Technology Programming	x	x	x		x	x
Numerical Methods	x	x	x		x	
Databases and their Management Systems	x	x	x		x	x
Basics of Physics I	x	x	x		x	
Basics of Physics II	x	x	x		x	
Programming for multilevel applications	x	x			x	x
Programming for Mobile Devices	x	x	x	x	x	x
MATLAB 1	x	x	x	x	x	x
MATLAB 2	x	x	x	x	x	x
Artificial Intelligence	x	x	x		x	x
Bachelor's thesis	x	x	x	x	x	x
Informatics Module						
Computer System Software	x	x	x	x	x	
Hardware-Oriented Programming	x	x	x		x	x
Computer Networks	x	x	x	x	x	x
Probability and Mathematical Statistics	x	x	x			
Web - Programming	x	x	x		x	x
Administration of Computer Networks	x	x	x	x	x	x
Computer Networks 2	x	x	x	x	x	x
Computer Virus Study	x	x	x	x	x	x
Cyber Security 1 (Information Security)	x	x	x	x	x	x
Basics of Computer Graphics Programming	x	x	x		x	x
Microelectronics module						
Basics of Electronics	x	x	x	x	x	x
Introduction to JAVA (Java in microelectronics)						
Low-bit Architecture Microprocessors and Programming. The first step in Robotics	x	x	x	x	x	x
Sensors - connection between the environment and electronics, electronics and information management computer display.	x	x	x	x	x	x
Schemes and designing electronic boards. Electronic equipment from idea to prototype	x	x	x	x	x	x
Programmable logic devices (FPGA)						
Linux-based Microcomputer Architecture and Programming. Electronic equipment, from idea to prototype	x	x	x	x	x	x

Appendix 8 – Georgian Technical University Electrical Engineering Curriculum

საქართველოს ტექნიკური უნივერსიტეტი
GEORGIAN TECHNICAL UNIVERSITY

BSc Program

Program Title

Electrical Engineering

Faculty

Power Energy and Telecommunication

Program Supervisor

Full professor Otar Zumburidze

Qualification and Program Credit Hours:

Bachelor of Engineering in Electrical Engineering
will be awarded for 240 credit hours envisioned by the educational program

Language of Study

English/Georgian

Program Goal:

Program goal is based on the study of basic principles and systems of Electrical Engineering

Specifically for:

Telecommunication - Transmission of Electromagnetic signals (including optic diapason); Distribution of Information; Building Telecommunication Networks (PSTN, Mobile, Cellular, TV and Radio Broadcasting, Multimedia); Management in Telecommunications.

Power - Preparation of competitive staff in the field of Energy and electrical engineer which is necessary: study of the electrical energy production technologies in the Hydro and thermal power plants; Long-distance transmission of power from the high voltage network, its distribution among consumers, the electrical parameters of the regulatory regimes, receive required knowledge of the electrical systems. Energy installations and equipment mounting, debugging, testing, maintenance and repair skills acquisition. Studying of Ecological and economic aspects of energy, non-traditional energy sources, energy-efficient technologies and techniques to improve the reliability of the power system.

Program admission criteria:

Any person holding general education State Certificate or equivalent document is eligible for the admission into the bachelor program through the Unified Entry Examination.

Program Learning Outcomes:

Telecommunication:

Sectoral Knowledge:

The main trends of development of telecommunication theory and technique; Theoretical background and mechanisms of circuit technique projection, switch nodes calculating and constructing, analog and discrete communication systems and equipment, data communication and telephone communication networks, channeling and end devices, electronic-control sets, mobile communication systems; The principles of construction and working of land and space radio communications, radio and television broadcasting, transceiver and antenna feeder technique; Management in Telecommunications;

Sectoral competences:

Construction of the communication networks (telephone, computer, data communication, television, radio-broadcasting, multimedia); Information security and methods of protecting the information from non-authorized turning on; Measurement of characteristics of telecommunication devices, equipments, channels and tracts, stations; The usage of methods of telecommunication theory in the neighboring areas related with information technologies

Power:

Knowledge and understanding –Have a broad knowledge in the field of energy and power engineering, which involves a critical understanding of theories and principles. Familiar with the main principles of the discipline, which involves complex issues, such as energy plant design, installation, testing, diagnosis, repair and operation of processes. Knowing labor protection, safety equipment, industrial sanitation and fire protection rules and regulations. Holds the proper terminology. Is aware about the connection between the energy sector in general and the energy subfields. Understands the importance of knowledge.

Ability to apply knowledge in practice – Have a wide range of cognitive and practical skills creatively to solve abstract problems in the field of energy; Have the ability to carry out their professional duties. Holds A complex energy field to identify the problem / solution in accordance with pre-established guidelines. Have a Ability of energy installations and equipment installation, maintenance, repair, operating parameters change, energy containing registration and quality control, technical documentation, working drawings and schemes reading.

Conclusion ability - has clearly outlined the problems inherent in the field of energy, and the ability to identify relevant data for the solution. Have ability of energy sphere specific data collection and interpretation as well as abstract data and /or situations and analysis with the standard and distinctive method. Have ability of the reasonable conclusion to establish energy installations, networks and systems, and the technical condition of the working capacity of the technical - economic requirements formulation. Assessment of Customer supplied power quality parameters, evaluate and regulation of these parameters.

Communication skills - structured and orderly transfer of ideas and information for a energy engineers and non a energy engineers using qualitative and quantitative information.Written and oral report preparation and presentation in energy and electrical engineering fields, namely in thermal and hydro power plants, energy system and energy installations non state processes. Creative use of modern information and communication technologies. Energy management programs, information gathering system (SCADA , etc.). , Processing, storage , and transmission capability . Discussion on the

professional level of participation in the project and prepare a detailed written report.

General competencies:

The skills of analysis and synthesis;
Ability to make a conclusion;
Practical application of knowledge skills;
The communication skills;
Team working.

Forms and Methodology of Study:

☒ Lecture ☒ Seminar (work in groups) ☒ case work ☒ Lab ☒ Practice/internship
☒ Project Paper ☒ Independent research

Grading scheme

It is possible for the student to receive/accumulate the credits only after achieving syllabus prescribed study results. Training course evaluation is a maximum 100% (points). In each course the assessment of student achievement is determined by the sum of weekly evaluations during the full academic semester, the mid-term exams evaluations and final exam evaluation.
Evaluation system provides for five types of positive evaluation:

- **(A)** Perfect – The maximum assessment of 91% or more;
- **(B)** Very good – The maximum assessment of 81 of 90%;
- **(C)** Good – The maximum assessment of 71 of 80%;
- **(D)** Satisfactory – The maximum assessment of 61 of 70%;
- **(E)** Sufficient – The maximum assessment of 51 of 60%.

Further Education:

Master Degree Programs in Electrical Engineering, Information Technologies and Applied Mathematics

Human and Technical Resources available for the Program:

Program is supported by adequate Human and Technical Resources, for more information see Syllabus.

First Two Year for Electrical Engineering Program

№		Course	ECTS Credits								Total
			1st Year		2nd Year		3rd Year		4th Year		
			Semester								
			I	II	III	IV	V	VI	VII	VIII	
1	CLC0E02	Mathematics 1	5								5
2	LNALE02	Mathematics 2		5							5
3	DSCME02	Mathematics 3			5						5
4	PRRPE02	Probability and Statistics				5					5
5	PHS1E02	Physic 1	5								5
6	PHS2E02	Physic 2		5							5
7	PHS3E02	Physic3			5						5
8	CMSKE08	Computer skills	5								5
9	FPRGE08	Fundamentals in Programing		5							5
10	FCAOE02	Fundamentals of Computer Architecture and Organization	5								5
11	ECRCE02	Circuit Theory 1		5							5
12	ECRCE02	Circuits Theory 2			5						5
13	DCGE102	Descriptive Geometry 1	3								3
14	DCGE202	Descriptive Geometry 2 (AutoCAD)		3							3
15	ELCE102	Electronics 1			5						5
16	ELCE202	Electronics 2				5					5
17	ELME102	Electromagnetics			5						5
18	CHE0E04	General Chemistry				5					5
19	THRDE02	Thermodynamics				5					5
20	FNL0E07	Foreign Languages	4	4	5	5					9
21	HUMNE02	Elective Courses (Humanities)	3	3							6
22	ECNME02	Fundamentals in Economics				5					5
		Total	**30**	**30**	**30**	**30**					**120**

Elective for Communications Third Year

№		Course	ECTS Credits								Total
			1st Year		2nd Year		3rd Year		4th Year		
			Semester								
			I	II	III	IV	V	VI	VII	VIII	
23	SIGE102	Signals Theory 1					5				5
24	SIGE202	Signals Theory 2						5			5
25	ELD0E02	Electronics 3					5				5
26	RFECE02	Radio Frequency Electronic					5				5

№		Course	ECTS Credits								Total
			1st Year		2nd Year		3rd Year		4th Year		
			Semester								
			I	II	III	IV	V	VI	VII	VIII	
		Circuits									
27	DIGCE02	Digital Communications						5			5
28	MTNE002	Modern telecommunication networks					5				5
29	WPATE02	Wave Propagations and Antenna Theory						5			5
30	FTNTE02	Fundamentals in Telecommunication Networks						5			5
31	MTNSE02	Measurement in Telecommunication Networks and Systems						5			5
32	TELME02	Telecommunications Marketing					5				5
33	FSMTE	Fundamentals of Strategic Management in Telecommunications						5			5
34	FMCE002	Fundamentals of mobile communication					5				
		Sub-Total					**30**	**30**			**60**

Elective for Communications Fourth Year

№		Course	ECTS Credits								Total
			1st Year		2nd Year		3rd Year		4th Year		
			Semester								
			I	II	III	IV	V	VI	VII	VIII	
34	FNPE002	Final Project								10	10
35	EMC0E02	Electromagnetic Compatibility							5		5
36	ELECE02	Electromagnetic Ecology								5	5
37	PJM0E02	Project Management							5		5
38	NPD0E02	New Product Development								5	5
39	OPTNE02	Optical Transport Networks								5	5
40	FOTLE02	Fiber-Optical Telecommunications							5		5
41	TGCSE02	Microwave and Satellite Transmission Systems							5		5
42	TXE0002	Transmitters							5		5
43	RXE002	Receivers							5		5
44	TRFE002	Traffic Engineering								5	5
		Sub-Total							**30**	**30**	**60**

Elective for Power third year **(65 credits)**

№		Course	ECTS Credits								Total
			1st Year		2nd Year		3rd Year		4th Year		
			Semester								
			I	II	III	IV	V	VI	VII	VIII	
23	AFM78E02	Applied fluid mechanics					5				5
24	MPE111E2	Marketing in Power Engineering					5				5
25	RNPS69E 02	Renewable and Nonconventional Power Sources					5				5
26	EPE1702	Electroteqnical materials					5				5
27	EL18E02	Electrical Machines-1					5				5
28	MI 16E02	Measurement and Instrumentation					5				5
29	EL18E02	Electrical Machines -2						5			5
30	LS027E03	Labor Safety and Emergency Management (Life Security) (Elective)						5			5
31	ED19E02	Electric Drives (Elective)						5			5
32	BEE16E02	Basic Electrical Engineering						5			5
33	ESE111E2	Electrical System Economics						5			5
34	OMS61E02	Operating Microprocessor Systems						5			5
35	TTH11E02	Technical Thermodynamics and Heat Transfer						5			5
		Sub-Total					**30**	**30**			**60**

Elective for Power Forth Year **(70 credits)**

№		Course	ECTS Credits								Total
			1st Year		2nd Year		3rd Year		4th Year		
			Semester								
			I	II	III	IV	V	VI	VII	VIII	
36	EPE17E02	Electrical Power Engineering-1							5		5
37	PEL61E02	Power Electronics							5		5
38	OM61E02	Operating Microprocessor Systems							5		5
39	ET17E02	Electromagnetic transient processes (Elective)							5		5
40	EM111E2	Engineering Management and Society							5		5
41	HCGE002	Cogeneration, Heat Conservation and Gas Turbine							5		5
42	SC17E02	Short circuits in power systems (Elective)							5		5
43	EPE17E02	Electrical Power Engineering-2								5	5

44	FEM0E02	Fundamentals of Engineering Management								5	5
45	EA11E02	Energy Audit (Elective)								5	5
46	EMS61E02	Embedded systems								5	5
47	FFPG11E02	Fossil Fuel Power Generation (Elective)								5	5
48	FNPE002	Final Project								10	10
		Sub-Total							**30**	**30**	**60**

Appendix 9 – SDSU Civil Engineering Course Requirements

Semester 1

LING 100. English Composition for International Students (3) [GE] Introduction to college-level written English; attention to English language/grammar needs of non-native speakers of English; grammatical and rhetorical techniques for effective writing, based in part on study of models of current American writing.

MATH 150. Calculus I (4) [GE] Algebraic and transcendental functions. Continuity and limits. The derivative and its applications. The integral and the fundamental theorem of calculus.

PHYS 195. Principles of Physics (3) Fundamental principles of physics in areas of mechanics and oscillatory motion. Designed for students requiring calculus-based physics.

PHYS 195L. Principles of Physics Laboratory (1) Three hours of laboratory. Prerequisite: Credit or concurrent registration in Physics 195. Experiments in mechanics, wave motion, resonance phenomena using precision air tracks.

ECON 102. Principles of Economics (3) [GE] Principles of economic analysis, economic institutions, and issues of public policy. Emphasis on direction of production, allocation of resources, and distribution of income, through the price system (microanalysis); and international economics.

CIV E 100. Introduction to Civil Engineering (1) Introduction to diverse field of civil and environmental engineering to include structural, geotechnical, water resources, transportation, construction engineering and management, and environmental engineering. Legal, ethical, and international dimensions of the profession.

Semester 2

LING 200. Advanced English for International Students (3) [GE] Prerequisites: Further practice in mastering conventions of standard academic writing, with emphasis on strategies for research in writing papers. Focus on language issues specific to non-native speakers of English.

COMM 103. Oral Communication (3) [GE] One lecture and two hours of recitation. Training in fundamental processes of oral expression; method of obtaining and organizing material; outlining; principles of attention and delivery; practice in construction and delivery of various forms of speeches.

MATH 151. Calculus II (4) [GE] Techniques and applications of integration. Improper integrals. Differential equations. Infinite series. Conic sections. Curves in parametric form, polar coordinates.

CHEM 202. General Chemistry for Engineers (4) Three lectures and three hours of laboratory. General principles of chemistry with emphasis on inorganic and physical chemistry and chemistry basics for engineers.

BIOL 100. General Biology (3) [GE] A beginning course in biology stressing processes common to living organisms.

Summer

POL S 101. Introduction to American Politics in Global Perspective (3) [AI] Politics and basic political concepts as applied to the American political system. American political system as a constitutional democracy viewed in comparative perspective and within context of the global system.

PHIL 101. Introduction to Philosophy: Ethics (3) [GE] Philosophical inquiry, with emphasis on problems of moral value. Students are encouraged to think independently and formulate their own tentative conclusions concerning a variety of vital contemporary issues facing individuals and society.

Semester 3

MATH 252. Calculus III (4) [GE] Functions of several variables. Vectors. Partial derivatives and multiple integrals. Line integrals and Green's Theorem.

PHYS 196. Principles of Physics (3) Fundamental principles of physics in areas of electricity and magnetism. Designed for students requiring calculus-based physics.

STAT 250. Statistical Principles and Practices (3) [GE] Descriptive statistics, data displays, measures of central tendency and variability, random variables, sampling distribution. Estimation and hypothesis tests for means and proportions, linear regression and correlation.

M E 200. Statics (3) Force systems, equilibrium, structures, distributed forces, friction, virtual work, moments of inertia, vector algebra.

CIV E 220. Civil and Environmental Engineering Computer Applications (3) Graphical information systems (GIS), specialized civil engineering software, advanced problem solving.

CON E 101. Construction and Culture (3) [GE] Cultural context of construction, emphasizing its centrality in evolution and expansion of built environments as expressions of ethical and historical value systems. Relationship between culture, geography, construction materials, and built expressions of cultural legacy. Interdependence of built environment and society.

Semester 4

POL S 102. Introduction to American and California Government and Politics (3) [AI] Political processes and institutions in the United States and California. Considers a variety of public policy issues such as environmental quality, health, education, relation between government and business, taxation, and foreign affairs as reflected in the dynamics of national and state politics.

GE Social & Behavioral Science (3)

A E 280. Methods of Analysis (3) Selected topics from ordinary differential equations, the Laplace transform, Fourier series, and linear algebra, with engineering applications.

A E 220. Dynamics (3) (Same course as Mechanical Engineering 220) Kinetics of a particle; central force motion; systems of particles; work and energy; impulse and momentum; moments and products of inertia; Euler's equations of motion; vibration and time response; engineering applications.

CIV E 218. Surveying for Civil Engineering and Construction (3) Two lectures and three hours of laboratory. Principles of plane surveying. Measurement of horizontal distance, difference in elevation, and angles. Traverse surveys and computations. Horizontal and vertical curves. Principles of stadia. Topographic surveys. Earthwork.

Semester 5

RWS 280. Academic Reading and Writing (3) Academic prose, emphasizing purposes, structures, and styles of academic writing, with particular emphasis on elements of argument. Designed to improve students' ability to plan, draft, revise, and edit essays, as well as to improve their ability to read and analyze complex academic texts.

RWS 281. Academic Reading and Writing for Second Language Learners and International Students (3) Academic prose, emphasizing purposes, structures, and styles of academic English writing. Designed to improve students' ability to plan, draft, revise, and edit essays, as well as to read and analyze complex academic texts. Additional emphasis on grammatical features of English relevant to the second language population.

CIV E 301. Introduction to Solid Mechanics (3) Mechanics of solid deformable bodies involving analytical methods for determining strength, stiffness, and stability of load-carrying members.

M E 304. Mechanics of Materials (3) Concepts of stress and strain. Generalized Hooke's law. Formulations for axial, shear, bending, torsion, and combined stresses applied to tension members, pinned joints, beams, and shafts. Euler buckling criteria for columns. Energy methods.

CIV E 302. Solid Mechanics Laboratory (1) Three hours of laboratory. Laboratory studies in solid mechanics. Experimental stress analysis. Experimental confirmation of theory.

CON E 430. Principles of Engineering Economy (3) Mathematics of finance applied to engineering and managerial decision making. Framework for cost management in engineering and construction.

A E 340. Fluid Mechanics (3) Fluid statics. Laminar and turbulent flow of liquids and gases in pipes, nozzles, and channels. Dimensional analysis and modeling. Drag forces on moving or immersed objects.

M E 350. Thermodynamics (3) Basic concepts and principles of thermodynamics with emphasis on simple compressible substances. First and second law analysis, entropy, exergy analysis and state relations.

Semester 6

CIV E 321. Structural Analysis I (3) Analysis of beams, frames, trusses, and three-dimensional frameworks. Influence lines; deflections; introduction to statically indeterminate structures and moment distribution.

CIV E 481. Transportation Engineering (3) Physical design of transportation facilities, traffic analysis and control for different modes, planning and demand analysis, introduction to environmental impacts of transportation systems and intelligent transportation systems.

ENV E 355. Environmental Engineering (3) Causes and effects of environmental problems and engineering methods to control them.

Summer

ISCOR 301. Conflict and Conflict Resolution (3) [GE] Conflict resolution as an emerging field; theories of conflict; methods and implications of conflict management including group, institutional, and international level analysis.

Semester 7

GE Explorations: Humanities PHIL 332. Environmental Ethics (3) [GE] Development of traditional values concerning the natural environment. Reasons for altering values in light of modern changes in relationship of human beings to the environment. Application of ethical principles to actions affecting the environment.

CIV E 401. Civil Engineering and Society (1) Role of civil engineers in society. Historical, political, esthetic, and philosophical perspectives on civil engineering. Contemporary issues involving civil engineering.

CIV E 421. Reinforced Concrete Design (3) Properties and characteristics of reinforced concrete; design of structural components. Introduction to plastic theory and limit design.

CIV E 444. Applied Hydraulics (3) Two lectures and three hours of laboratory. Prerequisite: Aerospace Engineering 340. Review of fluid statics. Forces on submerged surfaces. Close conduit flow. Pumps and turbines. Open-channel flow. Dams and reservoirs. Flood control.

CIV E 462. Geotechnical Engineering (3) Mechanics of soils as they apply to engineering problems, soil classification, compaction, swelling, consolidation, strength and permeability. Applications to geotechnical and environmental engineering problems.

CIV E 463. Geotechnical Engineering Laboratory (1) Three hours of laboratory. Laboratory procedures of soil testing for geotechnical and environmental engineering problems.

Semester 8

ECON 330. Comparative Economic Systems (3) [GE] Current economic systems from primarily laissez-faire to state-controlled market economies with a focus on nations of Asia, Europe and Latin America; Soviet-style economic planning and transition to a market economy.

CIV E 495. Capstone Design Project (3) One lecture and six hours of laboratory. Application of engineering principles and design techniques to the design of civil engineering projects.

TBD: Major Technical Elective

Appendix 10 – SDSU Construction Engineering Course Requirements

Semester 1

LING 100. English Composition for International Students (3) [GE] Introduction to college-level written English; attention to English language/grammar needs of non-native speakers of English; grammatical and rhetorical techniques for effective writing, based in part on study of models of current American writing.

MATH 150. Calculus I (4) [GE] Algebraic and transcendental functions. Continuity and limits. The derivative and its applications. The integral and the fundamental theorem of calculus.

PHYS 195. Principles of Physics (3) Fundamental principles of physics in areas of mechanics and oscillatory motion. Designed for students requiring calculus-based physics.

PHYS 195L. Principles of Physics Laboratory (1) Three hours of laboratory. Experiments in mechanics, wave motion, resonance phenomena using precision air tracks.

ECON 102. Principles of Economics (3) [GE] Principles of economic analysis, economic institutions, and issues of public policy. Emphasis on direction of production, allocation of resources, and distribution of income, through the price system (microanalysis); and international economics.

CIV E 100. Introduction to Civil Engineering (1) Introduction to diverse field of civil and environmental engineering to include structural, geotechnical, water resources, transportation, construction engineering and management, and environmental engineering. Legal, ethical, and international dimensions of the profession.

Semester 2

LING 200. Advanced English for International Students (3) [GE] Further practice in mastering conventions of standard academic writing, with emphasis on strategies for research in writing papers. Focus on language issues specific to non-native speakers of English.

COMM 103. Oral Communication (3) [GE] One lecture and two hours of recitation. Training in fundamental processes of oral expression; method of obtaining and organizing material; outlining; principles of attention and delivery; practice in construction and delivery of various forms of speeches.

MATH 151. Calculus II (4) [GE] Techniques and applications of integration. Improper integrals. Differential equations. Infinite series.Conic sections. Curves in parametric form, polar coordinates.

CHEM 202. General Chemistry for Engineers (4) Three lectures and three hours of laboratory. General principles of chemistry with emphasis on inorganic and physical chemistry and chemistry basics for engineers.

BIOL 100. General Biology (3) [GE] A beginning course in biology stressing processes common to living organisms.

Summer

POL S 101. Introduction to American Politics in Global Perspective (3) [AI] Politics and basic political concepts as applied to the American political system. American political system as a constitutional democracy viewed in comparative perspective and within context of the global system.

PHIL 101. Introduction to Philosophy: Ethics (3) [GE] Philosophical inquiry, with emphasis on problems of moral value. Students are encouraged to think independently and formulate their own tentative conclusions concerning a variety of vital contemporary issues facing individuals and society.

Semester 3

PHYS 196. Principles of Physics (3) Fundamental principles of physics in areas of electricity and magnetism. Designed for students requiring calculus-based physics.

STAT 250. Statistical Principles and Practices (3) [GE] Descriptive statistics, data displays, measures of central tendency and variability, random variables, sampling distribution. Estimation and hypothesis tests for means and proportions, linear regression and correlation.

M E 200. Statics (3) Force systems, equilibrium, structures, distributed forces, friction, virtual work, moments of inertia, vector algebra.

CON E 201. Construction Concepts and Building Codes (3) Concepts of control and information exchange in construction. Purpose and function of fundamental information flows, function, and development of construction-related codes and standards to protect public health and safety, compliance with requirements, and design using codes.

CIV E 220. Civil and Environmental Engineering Computer Applications (3) Graphical information systems (GIS), specialized civil engineering software, advanced problem solving.

CON E 101. Construction and Culture (3) [GE] Cultural context of construction, emphasizing its centrality in evolution and expansion of built environments as expressions of ethical and historical value systems. Relationship between culture, geography, construction materials, and built expressions of cultural legacy. Interdependence of built environment and society.

Semester 4

CIV E 218. Surveying for Civil Engineering and Construction (3) Two lectures and three hours of laboratory. Principles of plane surveying. Measurement of horizontal distance, difference in elevation, and angles. Traverse surveys and computations. Horizontal and vertical curves. Principles of stadia. Topographic surveys. Earthwork.

CON E 280. Construction Methods (3) One lecture and six hours of laboratory. Components and methods of construction including earthwork; foundations; wood, steel, and concrete construction; roofing and cladding; interior construction. Field experience in conducting and/or observing construction operations. Concepts of production in a construction setting.

GEOL 100. Planet Earth (3) [GE] Earth's global systems. Plate tectonics, earthquakes, and volcanoes; evolution of our planet and life through geologic time; economic resources including fossil fuels and precious minerals; agents of erosion that shape the land.

GEOL 101. Dynamics of the Earth Laboratory (1) [GE] Three hours of laboratory. Hands-on experience with land forms, rocks, minerals, topographic maps, and aerial photographs. Includes demonstrations and field trips.

ACCTG 201. Financial Accounting Fundamentals (3) Theory and practice of accounting applicable to recording, summarizing, and reporting of business transactions for external reporting and other external uses. Asset valuation; revenue and expense recognition; various asset, liability, and capital accounts.

Semester 5

RWS 280. Academic Reading and Writing (3) Academic prose, emphasizing purposes, structures, and styles of academic writing, with particular emphasis on elements of argument. Designed to improve students' ability to plan, draft, revise, and edit essays, as well as to improve their ability to read and analyze complex academic texts.

RWS 281. Academic Reading and Writing for Second Language Learners and International Students (3) Academic prose, emphasizing purposes, structures, and styles of academic English writing. Designed to improve students' ability to plan, draft, revise, and edit essays, as well as to read and analyze complex academic texts. Additional emphasis on grammatical features of English relevant to the second language population.

CIV E 301. Introduction to Solid Mechanics (3) Mechanics of solid deformable bodies involving analytical methods for determining strength, stiffness, and stability of load-carrying members.

CIV E 302. Solid Mechanics Laboratory (1) Three hours of laboratory. Laboratory studies in solid mechanics. Experimental stress analysis. Experimental confirmation of theory.

CON E 301. Construction Ethics, Law, and Contracts (3) Legal and ethical environment of construction. Study of documents and common procedures in construction administration and their legal and ethical contexts for general contractors and subcontractors. Contract documentation, claim in various construction delivery methods.

CON E 310. Analysis and Design of Construction Operations (3) Properties and methods for use of construction equipment and integration of construction equipment into production system. Assessment of equipment needs and selection. Site utilization and layout planning, incorporating efficiency and safety of operations.

CON E 312. Mechanical and Electrical Principles for Construction (3) Two lectures and three hours of laboratory. Engineering principles for mechanical, electrical, plumbing systems. Thermodynamics, energy principles, psychometrics. Electrical theory, circuits, motors. Static and dynamic principles for fluids, pipe flow. Mechanical and plumbing equipment.

Semester 6

CIV E 321. Structural Analysis I (3)

Analysis of beams, frames, trusses, and three-dimensional frameworks. Influence lines; deflections; introduction to statically indeterminate structures and moment distribution.

CON E 320. Construction Estimating (3)

Two lectures and three hours of laboratory. Identifying and estimating time and cost requirements for construction operations based on drawings and specifications. Use computer applications for estimating.

Summer

ISCOR 301. Conflict and Conflict Resolution (3) [GE] Conflict resolution as an emerging field; theories of conflict; methods and implications of conflict management including group, institutional, and international level analysis.

Semester 7

Humanities PHIL 332. Environmental Ethics (3) [GE] Development of traditional values concerning the natural environment. Reasons for altering values in light of modern changes in relationship of human beings to the environment. Application of ethical principles to actions affecting the environment.

CON E 401. Construction Planning and Scheduling (3) Two lectures and three hours of laboratory. Fundamentals of scheduling logic including critical path method, deterministic and probabilistic scheduling, and impact of constraints. Development of construction plan and representation in schedule format using common computer applications used in industry.

CON E 430. Principles of Engineering Economy (3) Mathematics of finance applied to engineering and managerial decision making. Framework for cost management in engineering and construction.

CIV E 462. Geotechnical Engineering (3)

consolidation, strength and permeability. Applications to geotechnical and environmental engineering problems.

CIV E 463. Geotechnical Engineering Laboratory (1) Three hours of laboratory. Laboratory procedures of soil testing for geotechnical and environmental engineering problems.

Semester 8

ECON 330. Comparative Economic Systems (3) [GE] Current economic systems from primarily laissez-faire to state-controlled market economies with a focus on nations of Asia, Europe and Latin America; Soviet-style economic planning and transition to a market economy.

CIV E 495. Capstone Design Project (3) One lecture and six hours of laboratory. Application of engineering principles and design techniques to the design of civil engineering projects.

CON E 479. Construction Materials (3) Two lectures and three hours of laboratory. Selection, design and control of mixes of Portland cement and asphalt concrete. Properties of these and other materials used in construction.

CON E 480. Design of Temporary Structures (3) Design of structures for temporary support of constructed work, including scaffolding and formwork, bracing, and excavations. Influence of codes and standards on the design process, selection of degrees of safety, and concepts of liability.

CON E 490. Construction Project Management and Safety (3) Management and control functions for construction projects. Execution of projects based on plan, estimate and bid documentation. Fundamentals of construction safety planning, design, and requirements.

TBD: Technical Elective

Appendix 11 – SDSU Chemistry/Biochemistry/Biotechnology Course Requirements

Semester 1

LING 100. English Composition for International Students (3) [GE] Introduction to college-level written English; attention to English language/grammar needs of non-native speakers of English; grammatical and rhetorical techniques for effective writing, based in part on study of models of current American writing.

MATH 150. Calculus I (4) [GE] Algebraic and transcendental functions. Continuity and limits. The derivative and its applications. The integral and the fundamental theorem of calculus.

PHYS 195. Principles of Physics (3) Fundamental principles of physics in areas of mechanics and oscillatory motion. Designed for students requiring calculus-based physics.

PHYS 195L. Principles of Physics Laboratory (1) Three hours of laboratory. Prerequisite: Credit or concurrent registration in Physics 195. Experiments in mechanics, wave motion, resonance phenomena using precision air tracks.

ECON 102. Principles of Economics (3) [GE] Principles of economic analysis, economic institutions, and issues of public policy. Emphasis on direction of production, allocation of resources, and distribution of income, through the price system (microanalysis); and international economics.

Semester 2

LING 200. Advanced English for International Students (3) [GE] Prerequisites: Further practice in mastering conventions of standard academic writing, with emphasis on strategies for research in writing papers. Focus on language issues specific to non-native speakers of English.

COMM 103. Oral Communication (3) [GE] One lecture and two hours of recitation. Training in fundamental processes of oral expression; method of obtaining and organizing material; outlining; principles of attention and delivery; practice in construction and delivery of various forms of speeches.

MATH 151. Calculus II (4) [GE] Prerequisite: Mathematics 150 with minimum grade of C. Techniques and applications of integration. Improper integrals. Differential equations. Infinite series. Conic sections. Curves in parametric form, polar coordinates.

CHEM 200. General Chemistry (5) Three lectures, one hour of discussion, and three hours of laboratory. General principles of chemistry with emphasis on inorganic materials.

Summer

POL S 101. Introduction to American Politics in Global Perspective (3) [AI] Politics and basic political concepts as applied to the American political system. American political system as a constitutional democracy viewed in comparative perspective and within context of the global system.

PHIL 101. Introduction to Philosophy: Ethics (3) [GE] Philosophical inquiry, with emphasis on problems of moral value. Students are encouraged to think independently and formulate their own tentative conclusions concerning a variety of vital contemporary issues facing individuals and society.

Semester 3

GE Humanities

GE Social & Behavioral Science

MATH 252. Calculus III (4) [GE] Prerequisite: Functions of several variables. Vectors. Partial derivatives and multiple integrals. Line integrals and Green's Theorem.

CHEM 201. General Chemistry (5) Three lectures, one hour of discussion, and three hours of laboratory. Prerequisite: Chemistry 200 or 202 with a grade of C or better. Continuation of Chemistry 200. General principles of chemistry with emphasis on fundamentals of chemical reactions.

CON E 101. Construction and Culture (3) [GE] Cultural context of construction, emphasizing its centrality in evolution and expansion of built environments as expressions of ethical and historical value systems. Relationship between culture, geography, construction materials, and built expressions of cultural legacy. Interdependence of built environment and society.

Semester 4

Writing Placement Assessment Exam

POL S 102. Introduction to American and California Government and Politics (3) [AI] Political processes and institutions in the United States and California. Considers a variety of public policy issues such as environmental quality, health, education, relation between government and business, taxation, and foreign affairs as reflected in the dynamics of national and state politics.

GE Social & Behavioral Science (3)

GE Life Science

PHYS 196. Principles of Physics (3) Fundamental principles of physics in areas of electricity and magnetism. Designed for students requiring calculus-based physics.

PHYS 196L. Principles of Physics Laboratory (1) Three hours of laboratory. Prerequisite: Credit or concurrent registration in Physics 196. Experiments in DC circuits, AC circuits, electrical resonance, oscilloscope measurement techniques, and electric and magnetic fields.

CHEM 232. Organic Chemistry (3) Prerequisites: Chemistry 201 with a grade of C or better and credit or concurrent registration in Chemistry 232L. Properties and synthesis of organic compounds including reaction mechanisms. Same course as lecture portion of Chemistry 231.

CHEM 232L. Organic Chemistry Laboratory (1) Three hours of laboratory. Prerequisites: Chemistry 201 with a grade of C or better and credit or concurrent registration in Chemistry 232. Properties and synthesis of organic compounds including methods of separation and purification techniques. Same course as laboratory portion of Chemistry 231.

CHEM 251. Analytical Chemistry (5) Three lectures and six hours of laboratory. Prerequisites: Chemistry 201 and credit or concurrent registration in Mathematics 122 or 150. Introduction to the theory and practice of analytical chemistry including gravimetric, volumetric, and instrumental methods.

Semester 5

RWS 280. Academic Reading and Writing (3) Academic prose, emphasizing purposes, structures, and styles of academic writing, with particular emphasis on elements of argument. Designed to improve students' ability to plan, draft, revise, and edit essays, as well as to improve their ability to read and analyze complex academic texts.

RWS 281. Academic Reading and Writing for Second Language Learners and International Students (3) Prerequisite: Open only to students who qualify for Rhetoric and Writing Studies 280. Academic prose, emphasizing purposes, structures, and styles of academic English writing. Designed to improve students' ability to plan, draft, revise, and edit essays, as well as to read and analyze complex academic texts. Additional emphasis on grammatical features of English relevant to the second language population.

GE Humanities

CHEM 410A. Physical Chemistry (4) Three lectures and three hours of laboratory. Prerequisites: Chemistry 232, 232L, 251; Mathematics 252 (Mathematics 150, 151; 252 or Physics 195, 195L, 196, 196L); Physics 195, 195L and 196, 196L. Theoretical principles of chemistry with emphasis on mathematical relations. Theory and practice in acquisition and statistical analysis of physical measurements on chemical systems.

CHEM 432. Organic Chemistry (3) Prerequisites: Chemistry 232 with a grade of C or better and credit or concurrent registration in Chemistry 432L. Continuation of Chemistry 232. Same course as lecture portion of Chemistry 431.

CHEM 432L. Organic Chemistry Laboratory (1) Three hours of laboratory. Prerequisites: Chemistry 232L with a grade of C or better and credit or concurrent registration in Chemistry 432. Continuation of Chemistry 232L. Same course as laboratory portion of Chemistry 431.

CHEM 560. General Biochemistry (3) Prerequisites: Chemistry 232, 232L, and credit or concurrent registration in Chemistry 410A, 432, 432L. The structure, function, metabolism, and thermodynamic relationships of chemical entities in living systems.

Semester 6

GE Social & Behavioral Science

GE Humanities

CHEM 410B. Physical Chemistry (3) Three lectures. Prerequisites: Chemistry 232, 232L, 251, 410A. Theoretical principles of chemistry with emphasis on mathematical relations. Theory and practice in acquisition and statistical analysis of physical measurements on chemical systems.

CHEM 417. Advanced Physical Chemistry Laboratory (2) Six hours of laboratory. Prerequisites: Chemistry 251, 410A, and credit or concurrent registration in Chemistry 410B. Experimental physical chemistry. Emphasis on interpretation and statistical evaluation of instrument-derived results, record keeping, report writing, and individual initiative in observing results.

CHEM 567. Biochemistry Laboratory (3) One lecture and six hours of laboratory. Prerequisite: Chemistry 560. Theory and practice of procedures used in study of life at molecular level. Includes purification and characterization of enzymes, isolation of cell components, and use of radioactive tracer techniques.

Elective (1)

Summer:

ISCOR 301. Conflict and Conflict Resolution (3) [GE] Conflict resolution as an emerging field; theories of conflict; methods and implications of conflict management including group, institutional, and international level analysis.

Semester 7

CHEM 457. Instrumental Methods of Chemical Analysis Laboratory (2) Six hours of laboratory. Prerequisites: Chemistry 251, 432, 432L, and credit or concurrent registration in Chemistry 410B; concurrent registration in Chemistry 550. Application of instrumental methods of chemical separations and analysis frequently used in all subdisciplines of chemistry.

CHEM 520A. Inorganic Chemistry (3-3) Prerequisite: Chemistry 410A. Chemistry 520A is prerequisite to 520B. Nature of chemical bond and an advanced systematic study of representative and transition elements and their compounds.

CHEM 550. Instrumental Methods of Chemical Analysis (2) Prerequisites: Chemistry 232, 232L, and credit or concurrent registration in Chemistry 410A; concurrent registration in Chemistry 457. Theory and application of those instrumental methods of chemical separation and analysis most frequently used in all subdisciplines of chemistry.

CHEM 563. Nucleic Acid Function and Protein Synthesis (2) Prerequisite: Chemistry 365 or 560. DNA replication, RNA transcription, RNA processing, and protein translation, including chemical mechanisms of synthesis and cellular mechanisms of regulating gene expression; genomics, recombinant DNA, and DNA topology.

Semester 8

ECON 330. Comparative Economic Systems (3) [GE] Current economic systems from primarily laissez-faire to state-controlled market economies with a focus on nations of Asia, Europe and Latin America; Soviet-style economic planning and transition to a market economy.

GE Explorations

CHEM 520B. Inorganic Chemistry (3-3) Prerequisite: Chemistry 410A. Chemistry 520A is prerequisite to 520B. Nature of chemical bond and an advanced systematic study of representative and transition elements and their compounds.

CHEM 427. Inorganic Chemistry Laboratory (1) Three hours of laboratory. Prerequisite: Credit or concurrent registration in Chemistry 520A. Laboratory course designed to introduce students to techniques used in synthesis, characterization, and manipulation of inorganic compounds and materials.

CHEM 562. Intermediary Metabolism (2) Prerequisite: Chemistry 365 or 560. Catabolic and biosynthetic pathways of carbohydrate, lipid, amino acid, and nucleotide metabolism; TCA cycle, mitochondrial and chloroplast electron transport chains, ATP generation and their interactions and control.

CHEM 564. Receptor Biochemistry and Protein Modification (2) Prerequisite: Chemistry 365 or 560. Biochemical study of receptors, second messengers, and cellular proteins that participate in extracellular and intracellular communication, with focus on protein structures, post-translational modifications, and biochemical mechanisms that regulate receptors and effector enzymes.

CHEM 498. Senior Project (1-3) Prerequisite: Individual literature and/or laboratory investigation and report on a problem. Maximum credit three units.

Appendix 12 – SDSU Computer Science Course Requirements

Semester 1

LING 100. English Composition for International Students (3) [GE] Introduction to college-level written English; attention to English language/grammar needs of non-native speakers of English; grammatical and rhetorical techniques for effective writing, based in part on study of models of current American writing.

MATH 150. Calculus I (4) [GE] Algebraic and transcendental functions. Continuity and limits. The derivative and its applications. The integral and the fundamental theorem of calculus.

PHYS 195. Principles of Physics (3) Fundamental principles of physics in areas of mechanics and oscillatory motion. Designed for students requiring calculus-based physics.

PHYS 195L. Principles of Physics Laboratory (1) Three hours of laboratory. Prerequisite: Credit or concurrent registration in Physics 195. Experiments in mechanics, wave motion, resonance phenomena using precision air tracks.

ECON 102. Principles of Economics (3) [GE] Principles of economic analysis, economic institutions, and issues of public policy. Emphasis on direction of production, allocation of resources, and distribution of income, through the price system (microanalysis); and international economics.

CS 107. Introduction to Computer Programming (3) Satisfaction of the Entry-Level Mathematics requirement. Programming methodology and problem solving. Basic concepts of computer systems, algorithm design and development, data types, program structures. Extensive programming in Java.

Semester 2

LING 200. Advanced English for International Students (3) [GE] Further practice in mastering conventions of standard academic writing, with emphasis on strategies for research in writing papers. Focus on language issues specific to non-native speakers of English.

COMM 103. Oral Communication (3) [GE] One lecture and two hours of recitation. Training in fundamental processes of oral expression; method of obtaining and organizing material; outlining; principles of attention and delivery; practice in construction and delivery of various forms of speeches.

MATH 151. Calculus II (4) [GE] Prerequisite: Mathematics 150 with minimum grade of C. Techniques and applications of integration. Improper integrals. Differential equations. Infinite series. Conic sections. Curves in parametric form, polar coordinates.

BIOL 100. General Biology (3) [GE] A beginning course in biology stressing processes common to living organisms.

Summer

POL S 101. Introduction to American Politics in Global Perspective (3) [AI] Politics and basic political concepts as applied to the American political system. American political system as a constitutional democracy viewed in comparative perspective and within context of the global system.

PHIL 101. Introduction to Philosophy: Ethics (3) [GE] Philosophical inquiry, with emphasis on problems of moral value. Students are encouraged to think independently and formulate their own tentative conclusions concerning a variety of vital contemporary issues facing individuals and society.

Semester 3

MATH 254. Introduction to Linear Algebra (3) [GE] Matrix algebra, Gaussian elimination, determinants, vector spaces, linear transformations, orthogonality, eigenvalues, and eigenvectors.

CS 237. Machine Organization and Assembly Language (3) General concepts of machine and assembly language, data representation, looping and addressing techniques, arrays, subroutines, macros. Extensive assembly language programming.

STAT 250. Statistical Principles and Practices (3) [GE] Descriptive statistics, data displays, measures of central tendency and variability, random variables, sampling distribution. Estimation and hypothesis tests for means and proportions, linear regression and correlation.

CON E 101. Construction and Culture (3) [GE] Cultural context of construction, emphasizing its centrality in evolution and expansion of built environments as expressions of ethical and historical value systems. Relationship between culture, geography, construction materials, and built expressions of cultural legacy. Interdependence of built environment and society.

Semester 4

POL S 102. Introduction to American and California Government and Politics (3) [AI] Political processes and institutions in the United States and California. Considers a variety of public policy issues such as environmental quality, health, education, relation between government and business, taxation, and foreign affairs as reflected in the dynamics of national and state politics.

GE Social & Behavioral Science (3)

Major Prep: 2nd Sequence of Phys or Life Sci + Lab

MATH 245. Discrete Mathematics (3) [GE] Logic, methods of proof, set theory, number theory, equivalence and order relations, counting (combinations and permutations), solving recurrence relations.

Semester 5

RWS 280. Academic Reading and Writing (3) -- Academic prose, emphasizing purposes, structures, and styles of academic writing, with particular emphasis on elements of argument. Designed to improve students' ability to plan, draft, revise, and edit essays, as well as to improve their ability to read and analyze complex academic texts.

RWS 281. Academic Reading and Writing for Second Language Learners and International Students (3) Academic prose, emphasizing purposes, structures, and styles of academic English writing. Designed to improve students' ability to plan, draft, revise, and edit essays, as well as to read and analyze complex academic texts. Additional emphasis on grammatical features of English relevant to the second language population.

CS 310. Data Structures (3) Representations and operations on basic data structures. Arrays, linked lists, stacks, queues, and recursion; binary search trees and balanced trees; hash tables, dynamic storage management; introduction to graphs. An object oriented programming language will be used.

CS 370. Computer Architecture (3) Logic gates, combinational circuits, sequential circuits, memory and bus system, control unit, CPU, exception processing, traps and interrupts, input-output and communication, reduced instruction set computers, use of simulators for analysis and design of computer circuits, and traps/interrupts.

Major Elective: MATH/STAT

Additional Approved Science

Semester 6

CS 320. Programming Languages (3) Principles of high-level programming languages, including formal techniques for syntax specification and implementation issues. Languages studied should include at least C++, FORTRAN, and LISP.

CS 530. Systems Programming (3). Design and implementation of system software. Relationship between software design and machine architecture. Topics from assemblers, loaders and linkers, macro processors, compilers, debuggers, editors. Introduction to software engineering and review of programming fundamentals and object oriented concepts. Large project in object oriented programming is required. Not acceptable for the M.S. degree in computer science.

Major Elective: CS

Additional Approved Science

Summer

ISCOR 301. Conflict and Conflict Resolution (3) [GE]Conflict resolution as an emerging field; theories of conflict; methods and implications of conflict management including group, institutional, and international level analysis.

Semester 7

Humanities PHIL 332. Environmental Ethics (3) [GE] Development of traditional values concerning the natural environment. Reasons for altering values in light of modern changes in relationship of human beings to the environment. Application of ethical principles to actions affecting the environment.

CS 440. Social, Legal, and Ethical Issues in Computing (3) Impact of computers, applications, and benefits, copyright, privacy, computer crime, constitutional issues, risks of computer failures, evaluating reliability of computer models, trade and communications in the global village, computers in the workplace, responsibilities of the computer professional.

CS 490. Senior Seminar (1) Preparation and delivery of oral presentations on advanced topics in computer science. General principles of organization and style appropriate for presenting such material.

CS 560. Algorithms and Their Analysis (3) Algorithms for solving frequently occurring problems. Analysis techniques and solutions to recurrence relations. Searching and sorting algorithms. Graph problems (shortest paths, minimal spanning trees, graph search, etc.). NP complete problems.

Major Elective: CS

Semester 8

ECON 330. Comparative Economic Systems (3) [GE] General Education prerequisite not required for Economics majors. Current economic systems from primarily laissez-faire to state-controlled market economies with a focus on nations of Asia, Europe and Latin America; Soviet-style economic planning and transition to a market economy.

CS 570. Operating Systems (3) Prerequisites: Computer Science 310, 370, and knowledge of the C programming language. File systems, processes, CPU scheduling, concurrent programming, memory management, protection. Relationship between the operating system and underlying architecture.

Major Elective: CS

Major Elective: CS

Elective

Appendix 13 – SDSU Electrical Engineering Course Requirements

Semester 1

LING 100. English Composition for International Students (3) [GE] Introduction to college-level written English; attention to English language/grammar needs of non-native speakers of English; grammatical and rhetorical techniques for effective writing, based in part on study of models of current American writing.

MATH 150. Calculus I (4) [GE] Algebraic and transcendental functions. Continuity and limits. The derivative and its applications. The integral and the fundamental theorem of calculus.

PHYS 195. Principles of Physics (3) Fundamental principles of physics in areas of mechanics and oscillatory motion. Designed for students requiring calculus-based physics.

PHYS 195L. Principles of Physics Laboratory (1) Three hours of laboratory. Prerequisite: Credit or concurrent registration in Physics 195. Experiments in mechanics, wave motion, resonance phenomena using precision air tracks.

ECON 102. Principles of Economics (3) [GE] Principles of economic analysis, economic institutions, and issues of public policy. Emphasis on direction of production, allocation of resources, and distribution of income, through the price system (microanalysis); and international economics.

Semester 2

LING 200. Advanced English for International Students (3) [GE] Further practice in mastering conventions of standard academic writing, with emphasis on strategies for research in writing papers. Focus on language issues specific to non-native speakers of English.

COMM 103. Oral Communication (3) [GE] One lecture and two hours of recitation. Training in fundamental processes of oral expression; method of obtaining and organizing material; outlining; principles of attention and delivery; practice in construction and delivery of various forms of speeches.

MATH 151. Calculus II (4) [GE] Prerequisite: Mathematics 150 with minimum grade of C. Techniques and applications of integration. Improper integrals. Differential equations. Infinite series. Conic sections. Curves in parametric form, polar coordinates.

BIOL 100. General Biology (3) [GE] A beginning course in biology stressing processes common to living organisms.

Summer

POL S 101. Introduction to American Politics in Global Perspective (3) [AI] Politics and basic political concepts as applied to the American political system. American political system as a constitutional democracy viewed in comparative perspective and within context of the global system.

PHIL 101. Introduction to Philosophy: Ethics (3) [GE] Philosophical inquiry, with emphasis on problems of moral value. Students are encouraged to think independently and formulate their own tentative conclusions concerning a variety of vital contemporary issues facing individuals and society.

Semester 3

MATH 254. Introduction to Linear Algebra (3) [GE] Matrix algebra, Gaussian elimination, determinants, vector spaces, linear transformations, orthogonality, eigenvalues, and eigenvectors.

MATH 252. Calculus III (4) [GE] Functions of several variables. Vectors. Partial derivatives and multiple integrals. Line integrals and Green's Theorem.

PHYS 196. Principles of Physics (3) Fundamental principles of physics in areas of electricity and magnetism. Designed for students requiring calculus-based physics.

PHYS 196L. Principles of Physics Laboratory (1) Three hours of laboratory. Experiments in DC circuits, AC circuits, electrical resonance, oscilloscope measurement techniques, and electric and magnetic fields.

COMPE 160. Introduction to Computer Programming (3) Two lectures and three hours of laboratory. Computer organization and operation. Binary representation of information. Fundamentals of computer programming using a C family language: data types, selection and iteration structures, functions, arrays, pointers, scope and duration of variables. Systematic design and development of computer programs.

COMPE 270. Digital Systems (3) Modeling, analysis and design of digital systems, primarily at the Logic Design level. Combinational and sequential networks.

CON E 101. Construction and Culture (3) [GE] Cultural context of construction, emphasizing its centrality in evolution and expansion of built environments as expressions of ethical and historical value systems. Relationship between culture, geography, construction materials, and built expressions of cultural legacy. Interdependence of built environment and society.

Semester 4

POL S 102. Introduction to American and California Government and Politics (3) [AI] Political processes and institutions in the United States and California. Considers a variety of public policy issues such as environmental quality, health, education, relation between government and business, taxation, and foreign affairs as reflected in the dynamics of national and state politics.

GE Social & Behavioral Science (3)

A E 280. Methods of Analysis (3) Selected topics from ordinary differential equations, the Laplace transform, Fourier series, and linear algebra, with engineering applications. (Formerly numbered Engineering 280.)

E E 210. Circuit Analysis I (3) Circuit analysis by reduction methods, Thevinin and Norton’s equivalence, mesh current and nodal voltage analysis. Transient analysis of first-order circuits and use of phasors for steady-state sinusoidal analysis. Operational amplifier models, impedance, power. Computer software tools for circuit analysis.

COMPE 271. Computer Organization (3) Organization and operation of computer hardware and software. Operating system shell and services. Program design and development. Input-output programming. Multi-module and mixed-language programming. Assembler and C language.

Semester 5

RWS 280. Academic Reading and Writing (3) Academic prose, emphasizing purposes, structures, and styles of academic writing, with particular emphasis on elements of argument. Designed to improve

students' ability to plan, draft, revise, and edit essays, as well as to improve their ability to read and analyze complex academic texts.

RWS 281. Academic Reading and Writing for Second Language Learners and International Students (3) Academic prose, emphasizing purposes, structures, and styles of academic English writing. Designed to improve students' ability to plan, draft, revise, and edit essays, as well as to read and analyze complex academic texts. Additional emphasis on grammatical features of English relevant to the second language population.

COMPE 375. Embedded Systems Programming (3) Two lectures and three hours of laboratory. Embedded system architecture; IO programming using parallel ports, serial ports, timers, and D/A and A/D converters; interrupts and real-time programming; program development and debugging tools; C language and assembler.

E E 300. Computational and Statistical Methods for Electrical Engineers (3) Random signals and events in electrical engineering. Introduction to basic probability, discrete and continuous random variables, joint random variables. Application of probabilistic models and concepts to engineering; data analysis and point estimation using computer-aided engineering tools.

E E 310. Circuit Analysis II (3) Transient and frequency response of RLC circuits. Mutual inductance, network analysis using Laplace transformations, network functions, stability, convolution integrals, Bode diagrams, two-port networks, computer analysis of circuits.

E E 330. Fundamentals of Engineering Electronics (3) Application of diodes JFETs, MOSFETs, and BJTs in typical electronic circuits. Analysis and design of rectifiers, filters, and simple amplifiers using transistors and operational amplifiers.

E E 330L. Engineering Electronics Laboratory (1) Three hours of laboratory. Experimental study of laboratory instruments, diodes, rectifier circuits, filters, transistors, and operational amplifiers.

Semester 6

E E 340. Electric and Magnetic Fields (3) Electrostatic and magnetostatic field theory using vector notation; Coulomb's Law, Gauss' Law and potential theory. Solutions to Poisson's and Laplace's equations; capacitance and inductance. Time-varying fields; Maxwell's equations.

E E 380. Electrical Energy Conversion (3) Magnetic circuits, transformers and polyphase AC networks. Fundamentals of electro-mechanical energy conversion; induction motors, synchronous machines and DC machines.

E E 410. Signals and Systems (3) File an approved master plan with the Department of Electrical and Computer Engineering. Linear time-invariant systems, Fourier analysis, continuous and discrete signals and systems, sampling and Laplace transform techniques.

E E 430. Analysis and Design of Electronic Circuits (3) Single and multiple transistor amplifiers, power stages. Frequency response, feedback, stability, and operational amplifier circuits.

Summer:

ISCOR 301. Conflict and Conflict Resolution (3) [GE] Conflict resolution as an emerging field; theories of conflict; methods and implications of conflict management including group, institutional, and international level analysis.

Semester 7

Humanities PHIL 332. Environmental Ethics (3) [GE] Development of traditional values concerning the natural environment. Reasons for altering values in light of modern changes in relationship of human beings to the environment. Application of ethical principles to actions affecting the environment.

E E 420. Feedback Control Systems (3) Control systems including servomechanisms by Laplace transform method. System performance and stability; Nyquist, Bode, and rootlocus diagrams; elementary synthesis techniques. Practical components and examples of typical designs.

E E 434. Electronic Materials and Devices (3) Crystal properties and growth of semiconductors, quantum mechanics of solids, shot noise and thermal noise, energy band and charge carriers, excess carrier in semiconductors, p-n junctions, solar cells, tunnel diodes, photodetectors.

E E 440. Electromagnetic Waves (3) Time-domain form of Maxwell equations, electromagnetic wave propagation in unbound media, Poynting vector, reflection of plane waves, transmission line theory, Smith chart, different microwave transmission lines, wave propagation in bounded media, waveguides, and introduction to antennas.

TBD: Major Elective w/Lab

TBD: Major Elective

Semester 8

ECON 330. Comparative Economic Systems (3) [GE] Current economic systems from primarily laissez-faire to state-controlled market economies with a focus on nations of Asia, Europe and Latin America; Soviet-style economic planning and transition to a market economy.

TBD: Major Elective w/Lab

TBD: Major Elective

E E 490. Senior Design Project (4) Two lectures and six hours of laboratory. Supervised capstone design projects to provide integrative design experience for seniors to include ethics, professionalism, cost-effectiveness, and project management.

Appendix 14 – SDSU Computer Engineering Course Requirements

Semester 1

LING 100. English Composition for International Students (3) [GE] Introduction to college-level written English; attention to English language/grammar needs of non-native speakers of English; grammatical and rhetorical techniques for effective writing, based in part on study of models of current American writing.

MATH 150. Calculus I (4) [GE] Algebraic and transcendental functions. Continuity and limits. The derivative and its applications. The integral and the fundamental theorem of calculus.

PHYS 195. Principles of Physics (3) Fundamental principles of physics in areas of mechanics and oscillatory motion. Designed for students requiring calculus-based physics.

PHYS 195L. Principles of Physics Laboratory (1) Three hours of laboratory. Experiments in mechanics, wave motion, resonance phenomena using precision air tracks.

ECON 102. Principles of Economics (3) [GE] Principles of economic analysis, economic institutions, and issues of public policy. Emphasis on direction of production, allocation of resources, and distribution of income, through the price system (microanalysis); and international economics.

Semester 2

LING 200. Advanced English for International Students (3) [GE] Further practice in mastering conventions of standard academic writing, with emphasis on strategies for research in writing papers. Focus on language issues specific to non-native speakers of English.

COMM 103. Oral Communication (3) [GE] One lecture and two hours of recitation. Training in fundamental processes of oral expression; method of obtaining and organizing material; outlining; principles of attention and delivery; practice in construction and delivery of various forms of speeches.

MATH 151. Calculus II (4) [GE] Techniques and applications of integration. Improper integrals. Differential equations. Infinite series. Conic sections. Curves in parametric form, polar coordinates.

BIOL 100. General Biology (3) [GE] A beginning course in biology stressing processes common to living organisms.

Summer

POL S 101. Introduction to American Politics in Global Perspective (3) [AI] Politics and basic political concepts as applied to the American political system. American political system as a constitutional democracy viewed in comparative perspective and within context of the global system.

PHIL 101. Introduction to Philosophy: Ethics (3) [GE] Philosophical inquiry, with emphasis on problems of moral value. Students are encouraged to think independently and formulate their own tentative conclusions concerning a variety of vital contemporary issues facing individuals and society.

Semester 3

MATH 254. Introduction to Linear Algebra (3) [GE] Matrix algebra, Gaussian elimination, determinants, vector spaces, linear transformations, orthogonality, eigenvalues, and eigenvectors.

PHYS 196. Principles of Physics (3) Fundamental principles of physics in areas of electricity and magnetism. Designed for students requiring calculus-based physics.

PHYS 196L. Principles of Physics Laboratory (1) Three hours of laboratory. Experiments in DC circuits, AC circuits, electrical resonance, oscilloscope measurement techniques, and electric and magnetic fields.

COMPE 160. Introduction to Computer Programming (3) Two lectures and three hours of laboratory. Computer organization and operation. Binary representation of information. Fundamentals of computer programming using a C family language: data types, selection and iteration structures, functions, arrays, pointers, scope and duration of variables. Systematic design and development of computer programs.

COMPE 270. Digital Systems (3) Modeling, analysis and design of digital systems, primarily at the Logic Design level. Combinational and sequential networks.

CON E 101. Construction and Culture (3) [GE] Cultural context of construction, emphasizing its centrality in evolution and expansion of built environments as expressions of ethical and historical value systems. Relationship between culture, geography, construction materials, and built expressions of cultural legacy. Interdependence of built environment and society.

Semester 4

Writing Placement Assessment Exam

POL S 102. Introduction to American and California Government and Politics (3) [AI] Political processes and institutions in the United States and California. Considers a variety of public policy issues such as environmental quality, health, education, relation between government and business, taxation, and foreign affairs as reflected in the dynamics of national and state politics..

ECON 102. Principles of Economics (3) [GE] Principles of economic analysis, economic institutions, and issues of public policy. Emphasis on direction of production, allocation of resources, and distribution of income, through the price system (microanalysis); and international economics.

COMPE 260. Data Structures and Object-Oriented Programming (3) Data structures using object-oriented programming. Disciplined approach to design, coding, and testing using OOP, teach use and implementation of data abstractions using data structures. Arrays, linked lists, stacks, queues, trees. Sorting, searching, recursive algorithms.

A E 280. Methods of Analysis (3) Selected topics from ordinary differential equations, the Laplace transform, Fourier series, and linear algebra, with engineering applications.

E E 210. Circuit Analysis I (3) Circuit analysis by reduction methods, Thevinin and Norton's equivalence, mesh current and nodal voltage analysis. Transient analysis of first-order circuits and use of phasors for steady-state sinusoidal analysis. Operational amplifier models, impedance, power. Computer software tools for circuit analysis.

COMPE 271. Computer Organization (3) Organization and operation of computer hardware and software. Operating system shell and services. Program design and development. Input-output programming. Multi-module and mixed-language programming. Assembler and C language.

Semester 5

RWS 280. Academic Reading and Writing (3) Academic prose, emphasizing purposes, structures, and styles of academic writing, with particular emphasis on elements of argument. Designed to improve students' ability to plan, draft, revise, and edit essays, as well as to improve their ability to read and analyze complex academic texts.

RWS 281. Academic Reading and Writing for Second Language Learners and International Students (3) Academic prose, emphasizing purposes, structures, and styles of academic English writing. Designed to improve students' ability to plan, draft, revise, and edit essays, as well as to read and analyze complex academic texts. Additional emphasis on grammatical features of English relevant to the second language population.

E E 300. Computational and Statistical Methods for Electrical Engineers (3) Random signals and events in electrical engineering. Introduction to basic probability, discrete and continuous random variables, joint random variables. Application of probabilistic models and concepts to engineering; data analysis and point estimation using computer-aided engineering tools.

E E 310. Circuit Analysis II (3) Transient and frequency response of RLC circuits. Mutual inductance, network analysis using Laplace transformations, network functions, stability, convolution integrals, Bode diagrams, two-port networks, computer analysis of circuits.

COMPE 361. Windows Programming (3) Object Oriented Programming (OOP) using C# and .NET Framework. Graphical User Interface (GUI) and event-driven programming. Visual Studio Integrated Development Environment (IDE). Graphics programming.

COMPE 470. Digital Circuits (3) Design of digital electronic systems using commercially available high-speed digital devices and circuits.

COMPE 375. Embedded Systems Programming (3) Two lectures and three hours of laboratory. Embedded system architecture; IO programming using parallel ports, serial ports, timers, and D/A and A/D converters; interrupts and real-time programming; program development and debugging tools; C language and assembler.

Semester 6

E E 330. Fundamentals of Engineering Electronics (3) Application of diodes JFETs, MOSFETs, and BJTs in typical electronic circuits. Analysis and design of rectifiers, filters, and simple amplifiers using transistors and operational amplifiers.

E E 330L. Engineering Electronics Laboratory (1) Three hours of laboratory. Experimental study of laboratory instruments, diodes, rectifier circuits, filters, transistors, and operational amplifiers.

E E 410. Signals and Systems (3) File an approved master plan with the Department of Electrical and Computer Engineering. Linear time-invariant systems, Fourier analysis, continuous and discrete signals and systems, sampling and Laplace transform techniques.

COMPE 475. Microprocessors (3) Bus design, memory design, interrupt structure, and input/output for microprocessor-based systems.

Summer

ISCOR 301. Conflict and Conflict Resolution (3) [GE] Conflict resolution as an emerging field; theories of conflict; methods and implications of conflict management including group, institutional, and international level analysis.

Semester 7

Humanities PHIL 332. Environmental Ethics (3) [GE] Reasons for altering values in light of modern changes in relationship of human beings to the environment. Application of ethical principles to actions affecting the environment.

COMPE 560. Computer and Data Networks (3) Wide area and local area networks, multi-layered protocols, telephone systems, modems, and network applications.

Semester 8

ECON 330. Comparative Economic Systems (3) [GE] Current economic systems from primarily laissez-faire to state-controlled market economies with a focus on nations of Asia, Europe and Latin America; Soviet-style economic planning and transition to a market economy.

TBD: Major Technical Elective

COMPE 490. Senior Design Project (4) Two lectures and six hours of laboratory. Supervised capstone design projects to provide an integrative design experience for seniors to include ethics, professionalism, cost effectiveness, and project management.

Appendix 15 - SDSU Electrical Engineering ABET Assessment Metrics

Electrical Engineering Program

1. Program Curriculum

This section describes how students are prepared for a professional career in Electrical Engineering as required by Criterion 5 of ABET. Our students are adequately prepared for practice of electrical engineering through a curriculum consisting of required and elective courses culminating in a major engineering design experience. The curriculum devotes adequate attention and time to mathematics, basic sciences and general education.

The Electrical Engineering curriculum requires a total of 130 semester units. The following sections discuss how this curriculum meets the ABET Professional Component requirement (Criterion 5).

Mathematics and Basic Sciences

The math and basic sciences requirement (1 year = 32 semester units) is currently satisfied by the following courses:

Course	Semester Units
Math150 Calculus I	4
Math151 Calculus II	4
Math 252, Calculus III	4
Math 254 Introduction to Linear Algebra	3
Engr280 Methods of Analysis	3
Life Sciences Elective	3
Phys195 Principles of Physics I	3
Phys 195L Principles of Physics Laboratory	1
Phys196 Principles of Physics II	3
Phys196L Principles of Physics Laboratory	1
EE300 Comp. and Stat. Methods for EE	3

Total	32

Discipline specific courses

The engineering requirement (1.5 years = 48 semester units) is currently satisfied by the following courses:

Course	Semester Units
CompE160 Intro to Computer Programming	3
EE210 Circuit Analysis I	3
CompE270 Digital Systems	3
CompE271 Computer Organization	3
CompE 375 Embedded System Programming	3
EE310 Circuit Analysis II	3
EE330 Fundamentals of Engineering Electronics	3
EE330L Engineering Electronics Laboratory	1

EE340 Electrical and Magnetic Fields	3
EE380 Electrical Energy Conversion	3
EE410 Signals and Systems	3
EE 420 Feedback Control Systems	3
EE430 Analysis and Design of Elec. Circuits	3
EE434 Electrical Materials and Devices	3
EE 490 Senior Design Project	4
EE Laboratory Electives	3
EE/CompE Electives	15

Total	62

The EE/CompE elective courses and elective laboratories provide advanced knowledge in those areas. Many of these elective courses, and other courses listed above have a significant design. However, it is the senior design course described below assures the major culminating design experience.

General Education

SDSU has a very strong General Education (GE) requirement that must be met by all students. The General Educational program at SDSU prepares students to succeed in an increasingly complex and rapidly changing world. Through this program, students will acquire knowledge of human cultures and the physical and natural world. They gain intellectual and practical skills such as inquiry and analysis, creative and critical thinking, written and oral communication.

Students are required to complete a minimum of 50 units in General Education. By special consideration, engineering students at SDSU are allowed to use 14 units of 50 units for both general education and preparation for the major. This leaves 36 units for taking courses drawn from four general education areas. They are:1) Communication and Critical Thinking; 2) Foundations of Learning; 3) American Institutions; and 4) Explorations of Human Experience.

Writing Requirement for Graduation

All the SDSU students must demonstrate competency in writing skills at the upper division level as a requirement for graduation. Students who achieve a score of 10 or above on the Writing Proficiency Assessment (WPA) examination satisfy the statewide Graduation Writing Assessment Requirement and do not have to take a writing course. Students who achieved a score of 8 or 9 are required to complete an approved upper division writing course with a grade of C or higher. Students who scored 7 or lower on WPA are required to complete Rhetoric and Writing Studies 280 or 281 with a grade of C or above before enrolling in one of the approved upper division writing courses.

Culminating Design Experience

The culmintating design experience for Electrical Engineering students is EE 490: Senior Design Project, and is required for all EE students. This is a 4 unit course taken by the students during their senior year. The students who are enrolled in this course are expected to accomplish certain well defined objectives. This course is team based and simulates an industrial environment. At the end of the course, the students should be able to demonstrate their competence in completing both individual level projects and projects that involve teams. They should be able to communicate their technical ideas both orally and in written

form. The students at the completion of the course should understand the importance of life long learning and should be aware of ethical dilemmas faced by engineers in their work environment. More specifically, we expect the students who have taken this course to achieve the following skills:

a) Demonstrate individual competence in designing and building a small system by completing an individual project;

b) Able to prepare an engineering proposal with the clear statement of specification, design criteria and deliverables;

c) Actively participate as a member of a design team and made significant contribution to achieving the team's goals and objectives;

d) Understand the benefits and problems of teaming;

e) Participate in several individual oral presenations;

f) Prepare well organized reports both for individual projects and the team design project;

g) Understand the ethical and professional issues faced by the engineers; and

h) Have an exposure to contemporary isssues and life long learning

To accomplish these goals, the course is divided into four parts.

1. Individual Design Project
2. Team Design Project
3. Regularly Scheduled Lectures
4. Mandatory attendance at IEEE Seminar Series

Individual Design Project: This activity is used to instill confidence and demonstrate individual competence in conceptualizing and designing a small project. This is important because many of the laboratory activities throughout the undergraduate curriculum are usually directed and involve more than one person. We found that this exercise also helps students to reinforce their experimental skills necessary for laboratory investigations necessary for the team design project.

Team Design Projects: During the first two weeks of the course, the students are given the general descriptions of design projects submitted by the faculty and industrial participants. A typical project description of a team project that dealt with an *Autonomous Robot for Search and Destroy operation* is given as follows:

Design and Construct an autonomous ground- based robot vehicle to navigate through a defined obstacle course consisting of land mines, detect their location and disable them.

Similar descriptions are distributed for all the available team projects in a given semester. The students are given an option of selecting one of these or suggesting a different project. Each selection is evaluated by the facilitator. Teams consist of 4- 5 members and are chosen to provide enough diversity of skills and personalities whenever possible.

Once the project is selected, the team prepares a proposal and submits to the " management team". The so called management team consists of the faculty members in charge of this course, and /or an industrial participant who submitted the project. The proposal includes problem definition, background research (if necessary) , conceptual system design, detailed task schedule , project management and budget. The students are required to prepare a Gantt Chart using Microsoft Project. Once the project started, the teams meet once a week with the management team at a scheduled time.

Apart from working on the project, the teams are required to :

- *create and maintain a website*
- *prepare and present design reviews and final seminar using power point*
- *submit a final written project report.*

The semester culminates with a day dedicated to showcase their designs called *Design Day*. Design Day activities include the poster presentation, and demonstration of the projects to the public at large. This is open to the public and is well advertised in the College. Furthermore, invitations are usually sent to local companies, alumni and other interested parties. The students not only enjoy showing of their projects but also get first hand experience in explaining the technical material to people with varied backgrounds.

Class Lectures and Student Presentations **:** The class has two scheduled lecture times each week. The classes are used for providing information about writing proposals, technical topics relevant to the projects, discuss topics such as ethics and oral presentations.

Ethics is a difficult topic. This topic is handled through a series of lectures based on the material obtained from industry, professional journals and case studies.

Student teams are required to present their project work three times during the semester to the entire class.The teams are required to use modern tools such as Power Point to prepare the presentations. The students in the class act as audience in all of these presentations and provide input on the quality and substance of each presentation. The final presentation is delivered to the public that usually includes faculty, students and engineers from industry who are also involved in the final evaluation of each team . This evaluation is used as one of the metrics in determining the final grade for the team.

Professional awareness and life long learning are definitely important for the graduating student. We provide exposure to these topics by bringing working engineers from local industry. The student branch of Institute of Electrical and Electronics Engineers (IEEE) arranges these meetings and is open to all faculty and students. Our capstone design students are required to attend these seminars. To make it possible for all the students to attend this seminar, the department does not schedule classes during that time.

The **achievement** of the course outcomes as listed earlier is measured by using both direct and indirect measures.

2. Course Assessment

The course assessment is divided into two parts: *Direct and Indirect.* The faculty responsible for each course has defined specific outcomes for that course. *Direct and Indirect measurement* tools are used to determine the achievement of these course outcomes.

Direct assessment consists of homeworks, examinations, class discussions and projects. The successful achievement of this outcome is measured by assigning a score of 1-4. The representation of this system is given below.

4= Mastery of the concept at A level

3= Master of the concept at t B level

2=Mastery of the concept at C level

1= Mastery of the concept at D level

Example: EE 210: Introductory Circuits course is used as an example to illustrate the process. The course outcomes defined for EE 210 course are:

1. *Able to understand and apply Kirchhoff's Voltage Law and Kirchhoff's Current Law*
2. *Able to recognize the differences between devices that are in series, in parallel or in no special configuration*
3. *Have the ability to analyze simple circuits using node voltage analysis and mesh current analysis*
4. *Able to understand how to apply the basic principles of superposition, source transformation and Thevinin/Norton Equivalence to reduce complex circuits*
5. *Have the ability to compute the transient response of simple RC and RL circuits subject to constant sources*
6. *Able to compute the steady-state response of simple circuits subject to sinusoidal sources, using the concepts of phasors*
7. *Able to analyze simple circuits containing operational amplifiers*
8. *Able to use Matlab and circuit software to analyze simple circuits*
9. *Have the ability to measure and analyze simple R, L, C circuits experimentally*

Direct Assessment*:* Achievement of the course outcomes are directly measured using the data collected during the semester in the form of homeworks and exams as shown in the following table.

Course outcomes	Homework/Labs	EX 1	EX 2	EX3	Final
1	x	x	x		x
2	x	x	x		x
3	x	x	x		x
4	x		x	x	x
5	x		x	x	x
6	x				x
7	x				x
8	x				
9	x				

Based on the rating defined above, and the data collected during the semester as given in the above table, the level of achievement is assessed for each of the course outcomes.

The following table represents the summary of the direct assessment of each outcome using a scale of 1-4 based on the above data.

Course outcomes	***Level of Achievement***
1	3.7
2	3.4
3	3.3
4	3.5
5	3.5
6	3.5
7	3.9
8	4
9	4

Indirect assessment of the course is obtained through student surveys during the semester. Student surveys are obtained during 8th week and 15th week. The information collected during the 8th week is used to adjust the class lectures and home works. The survey conducted at the 15th week provides some assessment of the effectiveness of mid-semester correction. The survey results for EE 210 are given below.

Course Outcomes	8th week	15th week
1	3.41	3.41
2	3.67	3.63
3	3.04	3.36
4	2.33	3.18
5	1.84	3.39
6	NA	2.91
7	NA	2.83
8	NA	2.14
9	NA	2.95

Student Instructional Rating forms (SIRR) forms completed by the students at the end of the semester along with these surveys and the faculty assessment of the course form the basis for the curriculum committee to take any appropriate action related to this course.

Finally, each instructor composes an evaluate summary at the conclusion of each course describing what went well, what went poorly, and what corrective actions should be taken, if necessary.

3. Assessment of the Capstone Design (EE490)

The direct and indirect assessments for the capstone design are described next along with the levels of achievement for the last three years.

Direct Assessment is obtained using the following information.

1) Grading of the proposal, written reports, web design

2) Demonstration of the individual project

3) Demonstration of the team project

2) Peer evaluation of the team members

3) Faculty evalution of the final presentation, demonstration of the team design and poster presentation on the Design Day

The results of direct assessment for the last three years are given on the next page.

Direct Assessment Results for EE 490: Senior Design

Course Outcomes	*Spring2007*	*Spring2008*	*Spring2009*
Be able to conceptualize the design an electrical system both from functionality and physical appearance	***3.22***	***3.07***	***3.25***
Be able to decompose the system and identify tasks	***3.22***	***3.07***	***3.27***
Be able to establish a task schedule using modern software tools	***3.00***	***3.6***	***3.19***
Able to select components and modules based on design specs	***3.49***	***3.54***	***3.48***
Obtain information about these components using data sheets	***3.75***	***3.72***	***3.61***
Be able to set up and test prototype circuits necessary for the design	***3.04***	***3.53***	***3.3***
Appreciation for team work	***3.41***	***3.15***	***2.93***
Able to design embedded systems using a microcontroller	***3.26***	***3.51***	***2.88***
Developed an ability to share and participate in discussions of engineering nature in determining the overall team design	***3.21***	***2.88***	***2.98***
Improved my oral and written communication of technical material using modern tools	***3.14***	***2.24***	***3.43***
Improved my ability to prepare technical proposals	***2.82***	***3.04***	***3.32***
Improved my understanding of ethical and professional issues	***2.78***	***3.53***	***3.82***

I*ndirect Assessment* is obtained through student surveys , advisory committee members and attendees at the Design Day and Final oral presentations. The surveys are taken at the beginning of the semester and the end of the semester. The results of the surveys for the last three years are given below.

Put a number between 1 and 4 , 4= Strongly agree, 3= Agree, 2= Neutral, 1= Disagree	**2007**		**2008**		**2009**	
Question	**B****	**E****	**B**	**E**	**B**	**E**
Be able to conceptualize the design an electrical system both from functionality and physical appearance	*2.18*	***3.39***	*2.55*	***3.48***	*2*	***3.65***
Be able to decompose the system and identify tasks	*2.3*	***3.47***	*2.5*	***3.5***	*2.94*	***3.62***
Be able to establish a task schedule using modern software tools	*2.19*	***3.27***	*2.21*	***3.24***	*1.82*	***3.32***
Able to select components and modules based on design specs	*2.27*	***3.18***	*2.2*	***3.24***	*1.94*	***3.68***
Obtain information about these components using data sheets	*2.45*	***3.47***	*2.6*	***3.76***	*2.29*	***3.85***
Be able to set up and test prototype circuits necessary for the design	*2.52*	***3.38***	*2.85*	***3.6***	*2.12*	***3.65***
Appreciation for team work	*3*	***3.24***	*3*	***3.81***	*2.85*	***3.74***
Able to design embedded systems using a microcontroller	*2.09*	***3.21***	*2.7*	***3.52***	*1.56*	***3.68***
Developed an ability to share and participate in discussions of engineering nature in determining the overall team design	*2.52*	***3.29***	*2.75*	***3.67***	*2.56*	***3.76***
Improved my oral and written communication of technical material using modern tools	*2.52*	***3.29***	*2.65*	***3.43***	*2.47*	***3.35***
Improved my ability to prepare technical proposals	*2.15*	***3.24***	*2.3*	***3***	*2.12*	***3.5***
Improved my understanding of ethical and professional issues	*2.22*	***2.97***	*2.58*	***3.2***	*2.15*	***3.3***

B = Beginning of the semester, E**= End of the semester**

Our results from both direct and indirect assessments indicate that the students level of achievement of the course objectives is between 3 and 4. Self evaluation by the students also revealed several insights into student learning. The students felt that the class helped them to become more confident in their ability to work with others, improved their ability to evaluate, design and validate new systems. They also

understand the importance of oral and written communication and felt that this class provided the tools and the training needed in this area. Many companies were impressed by the preparation of these students and recruited them for internships and immediate employment (Letter from SAIC in Appendix S.9) . We have also received unsolicited emails from people who are closely monitoring our program. (Appendix S.9). We have also received feedback from the advisory committee members (AppendixS.4). The students also said that this experience definitely helped them in their job interviews.

Appendix 16 - SDSU Computer Engineering ABET Assessment Metrics

Computer Engineering Program (COMPE)

1. Program Curriculum

The Bachelors Degree in Computer Engineering requires a total of 129 semester units. These 129 units include both required and elective courses, writing requirement, general education and culminating design experience as detailed below.

Mathematics and Basic Sciences Requirement

The math and basic sciences requirement of Criterion 5 (1 year = 32 semester units) is satisfied by the following courses:

Course	Semester Units
Math150 Calculus I	4
Math151 Calculus II	4
Math 245, Discrete Mathematics	3
Math 254 Introduction to Linear Algebra	3
Engr280 Methods of Analysis	3
Life Sciences Elective	3
Phys195 Principles of Physics I	3
Phys196 Principles of Physics II	3
Phys196L Principles of Physics Laboratory	1
EE300 Comp. and Stat. Methods for EE	3
Mathematics Elective	3

Total	33

Discipline Specific Courses

The engineering requirement of Criterion 5 (1.5 years = 48 semester units) is satisfied by the following courses:

Course	Semester Units
CompE160 Intro to Computer Programming	3
CompE260 Data Structures and OOP	3
EE210 Circuit Analysis I	3
CompE270 Digital Systems	3
CompE271 Computer Organization	3
EE310 Circuit Analysis II	3
EE330 Fundamentals of Engineering Electronics	3
EE330L Engineering Electronics Laboratory	1
CompE361 Windows Programming	3
CompE 375 Embedded System Programming	3
EE410 Signals and Systems	3
CompE 460 Software Engineering (or CS532)	3
CompE 470 Digital Circuits	3
CompE 470L Digital Logic laboratory	1
CompE 475 Microprocessors	3
CompE 490 Senior Design Project	4
Group A Electives (EE, CompE)	9
Group B Electives (EE, CompE or CS)	6

Total	60

The EE/CompE/CS elective courses and elective laboratories provide advanced knowledge in those areas. The list of acceptable courses as electives is distributed to the students.

General Education

SDSU has a very strong General Education (GE) requirement that must be met by all students. The General Educational program at SDSU prepares students to succeed in an increasingly complex and rapidly changing world. Through this program, students will acquire knowledge of human cultures and the physical and natural world. They gain intellectual and practical skills such as inquiry and analysis, creative and critical thinking, written and oral communication.

Students are required to complete a minimum of 50 units in General Education. By special consideration, engineering students at SDSU are allowed to use 14 units of 50 units for both general education and preparation for the major. This leaves 36 units for taking courses drawn from four general education areas. They are: 1) Communication and Critical Thinking; 2) Foundations of Learning; 3) American Institutions; and 4) Explorations of Human Experience.

Writing Requirement for Graduation

All the SDSU students must demonstrate competency in writing skills at the upper division level as a requirement for graduation. Students who achieve a score of 10 or above on the Writing Proficiency Assessment (WPA) examination satisfy the statewide Graduation Writing Assessment Requirement and do not have to take a writing course. Students who achieved a score of 8 or 9 are required to complete an approved upper division writing course with a grade of C or higher. Students who scored 7 or lower on WPA are required to complete Rhetoric and Writing Studies 280 or 281 with a grade of C or above before enrolling in one of the approved upper division writing courses.

Culminating Design Experience

The culmintating design experience for Computer Engineering students is CompE 490: Senior Design Project, and is required for all CompE students. This is a 4 unit course taken by the students during their senior year. The students who are enrolled in this course are expected to accomplish certain well defined objectives. This course is team based and simulates an industrial environment. At the end of the course, the students should be able to demonstrate their competence in completing both individual level projects and projects that involve teams. They should be able to communicate their technical ideas both orally and in written form. The students at the completion of the course should understand the importance of life long learning and should be aware of ethical dilemmas faced by engineers in their work environment. More specifically, we expect the students who have taken this course to achieve the following skills:

a) Demonstrate individual competence in designing and building a small system by completing an individual project;

b) Able to prepare an engineering proposal with the clear statement of specification, design criteria and deliverables;

c) Actively participate as a member of a design team and made significant contribution to achieving the team's goals and objectives;

d) Understand the benefits and problems of teaming;

e) Participate in several individual oral presenations;

f) Prepare reports both for the individual projects and the team design project;

g) Understand the ethical and professional issues faced by the engineers; and

h) Have an exposure to contemporary isssues and life long learning.

To accomplish these goals, the course is divided into four parts.

1. Individual Design Project
2. Team Design Project
3. Regularly Scheduled Lectures
4. Mandatory attendance at IEEE Seminar Series

*Individual Design Projects***.** The individual design projects instill confidence and demonstrate individual competence in conceptualizing and designing a system. This is important because many of the laboratory activities throughout the undergraduate curriculum are usually directed and involve more than one person. We found that this exercise also helps the students to reinforce their experimental skills necessary for laboratory investigations necessary for the team design project.

*Team Design Projects***.** During the first two weeks of the course, the students are given the general descriptions of design projects submitted by the faculty and industrial participants. An example of a typical project description is: *design and Construct an autonomous ground-based robot vehicle to navigate through a defined obstacle course, detect the location of land mines, and disable the mines.* Students are given an option of selecting one of the suggested projects, or proposing their own project. Students are assigned to teams of 4- 5 members each by the facilitator.

Each team prepares a proposal and submits it to the "management team". The management team consists of the faculty members in charge of this course, and /or an industrial participant who submitted the project. The proposal includes problem definition, background research (if necessary) , conceptual system design, detailed task schedule , project management and budget. The students are required to prepare a Gant Chart for the project development schedule using Microsoft Project. Once the project starts, each team meet weekly with its management team at a scheduled time. Apart from working on the project, the teams are required to :

- create and maintain a website
- prepare and present design reviews and final seminar using Power Point
- submit a final written project report.

The semester culminates with a day dedicated to showcase their designs called *Design Day*. Design Day activities include the poster presentation, and demonstration of the projects to the public at large. This is open to the public and is well advertised in the College. Furthermore, invitations are usually sent to local companies, alumni and other interested parties. The students not only enjoy showing of their projects but also get first hand experience in explaining the technical material to people with varied backgrounds.

*Class lectures and Student Presentations***.** The class has two scheduled lecture times each week. The classes are used for providing information about writing proposals, technical topics relevant to the projects, discuss topics such as ethics and oral presentations.

Ethics is a difficult topic. This topic is handled through a series of lectures based on the material obtained from industry, professional journals and case studies.

Student teams are required to present their project work three times during the semester to the entire class.The teams are required to use modern tools such as Power Point to prepare the presentations. The students in the class act as audience in all of these presentations and provide input on the quality and substance of each presentation. The final presentation is delivered to the public that usually includes faculty, students and engineers from industry who are also involved in the final evaluation of each team . This evaluation is used as one of the metrics in determining the final grade for the team.

Professional Awareness and Life Long learning are important issues for the graduating student. We provide exposure to these topics by bringing working engineers from local industry. The student branch of Institute of Electrical and Electronics Engineers (IEEE) arranges these meetings every Tuesday from 1100 to 12:30. The seminars are open to all faculty and students. To make it possible for everyone to attend the seminars, the department does not schedule classes during this time period. Students enrolled in CompE490 are required to attend the seminars.

2. Course Assessment

The course assessment is divided into two parts: *Direct and Indirect.* The faculty responsible for each course has defined specific outcomes for that course. *Direct and Indirect measurement* tools are used to determine the achievement of these course outcomes.

Direct assessment consists of homeworks, examinations, class discussions and projects. The successful achievement of this outcome is measured by assigning a score of 1-4. The representation of this system is given below.

4= Mastery of the concept at A level

3= Master of the concept at t B level

2=Mastery of the concept at C level

1= Mastery of the concept at D level

Example: EE 210: Introductory Circuits course is used as an example to illustrate the process. The course outcomes defined for EE 210 course are:

1. *Able to understand and apply Kirchhoff's Voltage Law and Kirchhoff's Current Law*
2. *Able to recognize the differences between devices that are in series, in parallel or in no special configuration*
3. *Have the ability to analyze simple circuits using node voltage analysis and mesh current analysis*
4. *Able to understand how to apply the basic principles of superposition, source transformation and Thevinin/Norton Equivalence to reduce complex circuits*
5. *Have the ability to compute the transient response of simple RC and RL circuits subject to constant sources*
6. *Able to compute the steady-state response of simple circuits subject to sinusoidal sources, using the concepts of phasors*
7. *Able to analyze simple circuits containing operational amplifiers*
8. *Able to use Matlab and circuit software to analyze simple circuits*
9. *Have the ability to measure and analyze simple R, L, C circuits experimentally*

Direct Assessment*:* Achievement of the course outcomes are directly measured using the data collected during the semester in the form of homework and exams as shown in the following table.

Course outcomes	Homework/Labs	EX 1	EX 2	EX3	Final
1	x	x	x		x
2	x	x	x		x
3	x	x	x		x
4	x		x	x	x
5	x		x	x	x
6	x				x
7	x				x
8	x				
9	x				

Based on the rating defined above, and the data collected during the semester as given in the above table, the level of achievement is assessed for each of the course outcomes.

The following table represents the summary of the direct assessment of each outcome using a scale of 1-4 based on the above data.

Course outcomes	***Level of Achievement***
1	3.7
2	3.4
3	3.3
4	3.5
5	3.5
6	3.5
7	3.9
8	4
9	4

Indirect assessment of the course is obtained through student surveys during the semester. Student surveys are obtained during 8th week and 15th week. The information collected during the 8th week is used to adjust the class lectures and home works. The survey conducted at the 15th week provides some assessment of the effectiveness of mid-semester correction. The survey results for EE 210 are given below.

Course Outcomes	8th week	15th week
1	3.41	3.41
2	3.67	3.63
3	3.04	3.36
4	2.33	3.18
5	1.84	3.39
6	NA	2.91
7	NA	2.83
8	NA	2.14
9	NA	2.95

Student Instructional Rating forms (SIRR) forms completed by the students at the end of the semester along with these surveys and the faculty assessment of the course form the basis for the curriculum committee to take any appropriate action related to this course.

Finally, each instructor composes an evaluate summary at the conclusion of each course describing what went well, what went poorly, and what corrective actions should be taken, if necessary.

3. Assessment of the Capstone Design (COMPE 490)

The direct and indirect assessments for the capstone design are described next along with the levels of achievement for the last three years.

Direct Assessment is obtained using the following information.

1) Grading of the proposal, written reports, web design

2) Demonstration of the individual project

3) Demonstration of the team project

2) Peer evaluation of the team members

3) Faculty evalution of the final presentation, demonstration of the team design and poster presentation on the Design Day

The results of direct assessment for the last three years are given on the next page.

Direct Assessment Results for COMPE 490: Senior Design

Course Outcomes	*Spring2007*	*Spring2008*	*Spring2009*
Be able to conceptualize the design an electrical system both from functionality and physical appearance	***3.22***	***3.07***	***3.25***
Be able to decompose the system and identify tasks	***3.22***	***3.07***	***3.27***
Be able to establish a task schedule using modern software tools	***3.00***	***3.6***	***3.19***
Able to select components and modules based on design specs	***3.49***	***3.54***	***3.48***
Obtain information about these components using data sheets	***3.75***	***3.72***	***3.61***
Be able to set up and test prototype circuits necessary for the design	***3.04***	***3.53***	***3.3***
Appreciation for team work	***3.41***	***3.15***	***2.93***
Able to design embedded systems using a microcontroller	***3.26***	***3.51***	***2.88***
Developed an ability to share and participate in discussions of engineering nature in determining the overall team design	***3.21***	***2.88***	***2.98***
Improved my oral and written communication of technical material using modern tools	***3.14***	***2.24***	***3.43***
Improved my ability to prepare technical proposals	***2.82***	***3.04***	***3.32***
Improved my understanding of ethical and professional issues	***2.78***	***3.53***	***3.82***

I*ndirect Assessment* is obtained through student surveys , advisory committee members and attendees at the Design Day and Final oral presentations. The surveys are taken at the beginning of the semester and the end of the semester. The results of the surveys for the last three years are given on the next page

Put a number between 1 and 4 , 4= Strongly agree, 3= Agree, 2= Neutral, 1= Disagree	2007		2008		2009	
Question	**B****	**E****	**B**	**E**	**B**	**E**
Be able to conceptualize the design an electrical system both from functionality and physical appearance	*2.18*	***3.39***	*2.55*	***3.48***	*2*	***3.65***
Be able to decompose the system and identify tasks	*2.3*	***3.47***	*2.5*	***3.5***	*2.94*	***3.62***
Be able to establish a task schedule using modern software tools	*2.19*	***3.27***	*2.21*	***3.24***	*1.82*	***3.32***
Able to select components and modules based on design specs	*2.27*	***3.18***	*2.2*	***3.24***	*1.94*	***3.68***
Obtain information about these components using data sheets	*2.45*	***3.47***	*2.6*	***3.76***	*2.29*	***3.85***
Be able to set up and test prototype circuits necessary for the design	*2.52*	***3.38***	*2.85*	***3.6***	*2.12*	***3.65***
Appreciation for team work	*3*	***3.24***	*3*	***3.81***	*2.85*	***3.74***
Able to design embedded systems using a microcontroller	*2.09*	***3.21***	*2.7*	***3.52***	*1.56*	***3.68***
Developed an ability to share and participate in discussions of engineering nature in determining the overall team design	*2.52*	***3.29***	*2.75*	***3.67***	*2.56*	***3.76***
Improved my oral and written communication of technical material using modern tools	*2.52*	***3.29***	*2.65*	***3.43***	*2.47*	***3.35***
Improved my ability to prepare technical proposals	*2.15*	***3.24***	*2.3*	***3***	*2.12*	***3.5***
Improved my understanding of ethical and professional issues	*2.22*	***2.97***	*2.58*	***3.2***	*2.15*	***3.3***

B = Beginning of the semester, E**= End of the semester**

Our results from both direct and indirect assessments indicate that the students level of achievement of the course objectives is between 3 and 4. Self evaluation by the students also revealed several insights into student learning. The students felt that the class helped them to become more confident in their ability to work with others, improved their ability to evaluate, design and validate new systems. They also understand the importance of oral and written communication and felt that this class provided the tools and the training needed in this area. Many companies were impressed by the preparation of these students and recruited them for internships and immediate employment. We have also received unsolicited emails from people who are closely monitoring our program. We have also received feedback from the advisory committee members.. The students also said that this experience definitely helped them in their job interviews.

Appendix 17 - SDSU Chemistry ACS Assessment Metrics

SDSU Chemsitry
Undergraduate Curriculum

The Department of Chemistry and Biochemistry at SDSU offers six undergraduate major degree programs along with a minor in Chemistry. The required classroom course work provides our undergraduate students with a solid knowledge base in the major disciplines in chemistry, but the hallmark of our program has always been and continues to be a strong laboratory component, featuring full-time faculty teaching advanced lab courses, and a very active undergraduate research program. Two of the degrees, the Chemistry B.S. in Applied Arts and Sciences, and the Chemistry B.A. in Liberal Arts and Sciences, are accredited by the American Chemical Society (ACS), which is the major accrediting agency for chemistry in the U.S. The ACS conducts a comprehensive review of the programs every 5 years, and requires annual updates on both programs. The last comprehensive review was in 2010, and there were no issues with our programs at that time. The next one is expected in 2015. In addition to the ACS accredited degrees, we offer a B.S. Chemistry degree with an Emphasis in Biochemistry and a non-accredited Chemistry B.A. degree. The latter is intended mainly for pre-med students. The final two degrees are the Chemistry B.A. in Applied Arts and Sciences in preparation for the single-subject teaching credential and the Chemical Physics B.S. in Applied Arts and Sciences.

The vast majority (95%) of SDSU chemistry undergraduates are in either the Biochemistry B.S. or the ACS-accredited B.S. degree programs. Recently, the percentages were 50% in Biochemistry and 44% in the ACS B.S. programs. The department has not made major changes in the curriculum for any of the undergraduate degree programs in the last 5 years; however, some minor changes were made to better ensure that the students were prepared for the courses. For example, in AY 2009-10, the department initiated a required placement exam for Chem 200, the first-semester General Chemistry for science majors. To enroll in Chem 200, students must pass this exam or pass Chem 100, a lower-level preparatory class, with a C grade or better. In addition, starting in the same year, we specified that students could not move on to Chem 201 (second-semester Gen Chem) without a C grade or better in Chem 200. Similar prerequisites were put in place for the first- and second-semester Organic Chemistry, Chem 232 and 432. After these prerequisites were put in place, a significant jump in both student GPA (up 0.5 units) and passing rate (up 20%) were observed in Chem 232 in Spring 2011, and these increases have been maintained since 2011. To our satisfaction, the failure rates also dropped significantly in Spring 2011 to lower than 10%.

Undergraduate research plays an important role in all our degree programs. At least 1 unit of research is a required component, but most of the students do substantially more either as Chem 497 (credit/no credit with no report required, up to 6 units count towards degree) or Chem 498 (graded with required written report, up to 3 units count towards degree). Our faculty members accept undergraduates in their group, and most have several at a time, giving students a wide variety of different research opportunities, providing them with invaluable, practical experience.

Diversity

The Department of Chemistry and Biochemistry at SDSU has a balanced population between female (57%) and male undergraduate students and a large population of underrepresented

students (50%). These numbers are better than those of many chemistry undergraduate programs in the country. Based on our past experience, we are confident that we can recruit women and underrepresented students to our proposed SDSU-Georgia chemistry programs and build a program with a diverse population.

SDSU Chemistry Undergraduate Student Diversity

Semester	Total Headcount	Headcount (%) Women	Headcount (%) Underrepresented[a]	Headcount (%) International
Fall 2012	312	177 (56.7)	145 (50.3)	7 (2.4)
Fall 2011	311	174 (55.9)	149 (49.2)	11 (3.6)
Fall 2010	277	162 (58.5)	141 (50.9)	7 (2.5)
Fall 2009	303	169 (55.8)	172 (55.3)	5 (1.6)
Fall 2008	288	159 (55.2)	183 (58.7)	7 (2.2)

[a] underrepresented defined as: African-American, American Indian, Filipino, Mexican-American, multiple ethnicities, Hispanic, Pacific Islander, or Southeast Asian.

SDSU Chemistry Undergraduate Degrees Granted

Academic Year	Total	Women (%)	Men (%)
2011-12	36	16 (44.4)	20 (55.6)
2010-11	39	22 (56.4)	17 (43.6)
2009-10	38	20 (52.6)	18 (47.4)
2008-09	32	15 (46.9)	17 (53.1)
2007-08	32	17 (53.1)	15 (46.9)

SDSU Chemistry Female and Male Graduate Students Enrolled

Chemistry/Biochemistry (Code 19051)	Female (%)	Male (%)	Total
Fall 2012	24 (35%)	44 (65%)	68
Fall 2011	27 (40%)	41 (60%)	68
Fall 2010	28 (37%)	47 (63%)	75
Fall 2009	30 (40%)	45 (60%)	75
Fall 2008	33 (44%)	42 (56%)	75

SDSU Chemistry Underrepresented Graduate Students Enrolled

Chemistry/Biochemistry (Code 19051)	Fall 2008	Fall 2009	Fall 2010	Fall 2011	Fall 2012
African American	1	1	1	2	2
Native American	1	0	0	0	0
Asian	8	7	7	7	7
Filipino	5	5	3	2	0

International	18	19	18	14	11
Hispanic (Mexican Am)	2	4	4	2	2
Multiple Ethnicities	0	1	3	4	4
Other Hispanic	1	2	2	1	1
Southeast Asian	3	2	2	3	3
Total Underrepresented	39 (52%)	41 (55%)	40 (53%)	35 (52%)	30 (44%)
White	27 (36%)	27 (36%)	26 (35%)	26 (38%)	27 (40%)
Other/Not Stated	9 (12%)	7 (9%)	9 (12%)	7 (10%)	11 (16%)
Total	75	75	75	68	68

Student Learning Outcomes

We have adopted a detailed set of student learning outcomes (SLO) and assessment methodologies to measure them. Since our SLOs largely derive from the goals set out by the American Chemical Society, our accrediting agency, one of the assessment tools one could use is based on the American Chemical Society Committee on Professional Training's extensive guidelines and evaluation procedures for chemistry programs. For example, we have identified our tasks as
(1) to determine what laboratory skills should be expected of senior chemistry majors,
(2) to determine in what courses such skills should be delivered, and
(3) to determine how often those basic skills should be repeated to ensure the required degree of competence.

In addition, we continued to focus on how students perceive the education they have received at SDSU. The combination of
(1) the ACS 5-Year Review, which represents how our colleagues perceive what we are offering our students, and
(2) student satisfaction surveys, which indicate how the students perceive what they have been given, is a useful "yin and yang" and it provides what we believe to be a more balanced view of the program as compared to that provided by either measure alone.

We have also continued to give out our "exit interview" survey forms to our graduating seniors for compilation. We have also given out "pretests" in our senior courses that are designed to determine what laboratory skills the students *actually* have when they arrive in these classes rather than what we *think* they have. This information was then used to drive any needed changes in curriculum.

The ACS results indicate that the SDSU Chemistry Program continues to provide professionally trained students in chemistry. That is not to say that improvements within the ACS mandated guidelines could not be made. Exit surveys generally back up this view; however due to low response rates, it takes a number of years to produce statistically meaningful results via this instrument.

Assessment Goals: General Overview

Students obtaining a baccalaureate chemistry degree should have upon graduation
1) general familiarity with the following areas in chemistry: analytical, biochemistry, inorganic, organic and physical.
2) the ability to work effectively and safely in a laboratory environment.
3) the ability to use the power of computers in applications in chemistry.
4) the ability to communicate effectively, both orally and in writing.
5) learned how to think critically and analyze chemical problems.
6) the ability to work in teams as well as independently.
7) developed formal (abstract) thinking skills as well as concrete thinking skills.
8) the ability to initiate their career following graduation.

The preceding goals can partially be met by a chemistry department:

1) having timely and effective advising of students.
2) providing capstone experiences for students with independent projects strongly encouraged.
3) providing opportunities for students and faculty to interact with alumni and with professional chemists.
4) having dialogues with colleagues in departments servicing chemistry students.
5) providing modern laboratory experiences.
6) providing modern computing resources involving chemical applications.

Assessment Goals: Details - Laboratory Knowledge and Skills

Students obtaining a baccalaureate chemistry degree should have upon graduation

1) the basic analytical and technical skills to work effectively in the various fields of chemistry.
2) the ability to perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions.
3) the ability to synthesize, separate and characterize compounds using published reactions, protocols, standard laboratory equipment, and modern instrumentation.
4) the ability to use information technology tools such as the Internet and computer-based literature searches as well as printed literature resources to locate and retrieve scientific information needed for laboratory or theoretical work.
5) the ability to present scientific and technical information resulting from laboratory experimentation in both written and oral formats.
6) knowledge and understanding of the issues of safety regulations, ethics and societal issues in the use of chemicals in their laboratory work.

Assessment Goals: Detailed - Computer, Library and Information Skills

Students obtaining a baccalaureate chemistry degree should have upon graduation

1) the ability to make effective use of the library and other information resources in chemistry, including (a) finding chemical information utilizing the primary literature, (b) critically and ethically evaluating chemical information, (c) finding and evaluating chemical information utilizing secondary sources such as the Internet.
2) the ability to make effective use of computers in chemistry applications, including (a) using a computer as a tool in writing, drawing chemical structures and data analysis to communicate scientific information, (b) having a familiarity with the applications of computers in the modeling and simulation of chemical phenomena, (c) having an appreciation of the applications of computers in data acquisition and processing, (d) retrieval of information using library or internet resources.

Assessment Goals: Detailed - Oral and Written Communication Skills in Chemistry; Ethics in Chemistry

Students obtaining a baccalaureate chemistry degree should have upon graduation

1) adequate skills in technical writing and oral presentations. [Students must be given the opportunity to practice effective writing and oral communication throughout the chemistry curriculum.]
2) the ability to communicate scientific information in oral and written formats to both scientists and nonscientists.
3) an understanding of current ethical issues in chemistry and be able to apply ethical principles in classes and research.

Assessment Goals: Detailed - Quantitative Reasoning Skills

Students obtaining a baccalaureate chemistry degree should have upon graduation

1) sufficient quantitative reasoning skills to successfully pursue their career objectives, a related career or further professional training.
2) developed their (a) proficiency in algorithmic and calculation skills, (b) ability to accurately collect and interpret numerical data, (c) ability to solve problems competently using extrapolation, approximation, precision, accuracy, rational estimation and statistical validity, (d) ability to relate theories involving numbers and the practice of the theory, (e) proficiency in the scientific method (formulating hypotheses and arriving at appropriate answers and conclusions)

Assessment Goals: Detailed - Knowledge of Chemical Principles and Facts; Appreciation for Chemistry as a Discipline

Students obtaining a baccalaureate chemistry degree should have upon graduation

1) developed a mastery of critical thinking skills, problem-solving skills and data analysis skills leading to the ability to (a) collect and analyze data, (b) apply fundamental chemical principles to gather and explain data, (c) design experiments or model systems to test hypotheses, (d) assess the relative validity of several possible solutions to a problem.
2) a working knowledge of chemical principles appropriate to a chemistry degree program
3) a mastery of a broad set of factual chemical knowledge concerning the properties of substances, molecules and atoms.

Assessment Measures

(1) ACS Accreditation. The curricula in chemistry for the B.A. and B.S. degrees are approved by the American Chemical Society (ACS), which reviews our course offerings, laboratory facilities, instrumentation, examinations, student undergraduate research reports, etc., every five years. Students who successfully complete all of the required courses and approved electives in the chemistry program obtain an ACS certified baccalaureate degree. The ACS appoints a review team to conduct an on-site inspection, interview faculty, students, and staff, and evaluate our entire undergraduate chemistry program. For the past fifty years, our undergraduate chemistry major program has passed this external review and evaluation.

2) Student Graduation Survey. Over the past three years, we have tracked where our undergraduate chemistry majors go and what they do after graduation. About half of them go on to graduate schools, about 40% obtain employment in industry or government, the remaining percentage of chemistry majors enter professional schools in medicine, law, etc., or are secondary school chemistry teachers. From time to time we receive reports from employers or graduate schools about the success of our chemistry majors. The success of our undergraduates over many years demonstrates the validity of the Assessment Measure.

3) Undergraduate Research. Chemistry undergraduate majors who take Chem 497 or Chem 498 (Undergraduate Chemistry Research) often give oral presentations in research group meetings, present posters of their chemistry research at chemistry or honors poster sessions, or present research papers (oral presentations) at regional or national meetings of the American Chemical Society. Successful credits earned in this course is an indicator that the student
(1) demonstrates the ability to use modern library searching and retrieval methods to obtain information about a topic, chemical, chemical technique, or an issue relating to chemistry,
(2) knows the proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals, and
(3) knows how to communicate the results of their work to chemists and non-chemists.

4) Student/Faculty Surveys. These surveys are very important and valuable and we plan to use them as much as possible and as personnel budget allows.

Current Assessment Efforts

Our assessment efforts have been carried out more slowly than desirable partly because our faculty members have been stretched too thin, in particular to cover the increasing teaching loads of the many required courses. Our faculty members are slowly getting the training on assessment using a systematic approach where assessment, is linked to specific learning outcomes. In the past, our assessment endeavors revolved around placement exams, American Chemical Society subject exams, and students exit questionnaires. Some of the data collected in the past are shown below.

Exam Results

Majors Exam 2008	
Students population	Correct answers
Juniors	64%
Seniors	78%
Graduate students	78%

Data in the table above suggest that our students increase their understanding of chemistry between their junior and senior year.

ACS Cumulative Physical Chemistry Exam Scores

ACS Cumulative Physical Chemistry Exam	
Year	Average Score/Possible Score
2005	22/60
2008	25/60
2009	23/60
2012	24/60

Data in the table above suggest that student performance in physical chemistry was stable between 2005 and 2012.

The two tables above show that we were trying to measure student performance on standardized test in order to compare our students with the national student population. However, these data do not differentiate performance by learning outcome.

A slightly better attempt is shown in the table below, where the data reflect student performance in a single course. In this table, student performance is differentiated by learning outcome, so that we can find out which concepts are retained and which ones are not. This test has been given only once so far, and it does not yet yield information on the changes in student performance over time.

General Chemistry Assessment Quiz Scores

General Chemistry Assessment Quiz 2009	
Learning Outcome	Score
Balance equations	98%
Use molarity and molecular mass	69%
Describe redox reactions	88%
Use $\Delta G°$ and K_{eq}	81%
Use $\Delta G°$ and K_{eq}	87%
Name chemicals	71%
Name chemicals	81%
Acid-base chemistry	83%
Advanced acid-base chemistry	38%

In the last few years, assessment and student learning outcomes have been discussed in more detail at faculty meetings and workshops on campus. We are realizing that assessment is really a method that can be used to evaluate and improve our educational programs. We have also come to realize that assessment should be an ongoing process and that it needs to be done continuously and systematically. Finally, we have also learned that assessment can work properly only if it is based on a sound set of learning outcomes.

Currently at SDSU, our fledging assessment program is focused on the use of WEAVE and the construction of curricular matrices. WEAVE is a web-based tool designed to help academic programs to manage their assessment efforts. Our faculty members are in the process of learning how to use WEAVE. We have also begun to populate various sections of WEAVE with information regarding our department. During faculty discussions, it has become evident that we need an extended and improved curriculum matrix that will be used as a basis for learning assessment. The Department Curriculum Committee is currently working on compiling student learning outcome data for the various degree programs. These matrices will be used to organize our educational efforts. In addition, they will be used as a basis for the design of a suite of student learning assessment tools. These tools will be used to answer some important questions including: What do we expect our students to know when they arrive on campus? What do they actually know? What do we expect them to learn in our various degree programs? Are we successful in teaching our students? What can we change to increase student learning? Populating WEAVE is an on-going process all the time and we are grateful to Professor van der Geer for taking on this challenging task for the department.

Feedback

Feedback from actual employers is not gathered systematically, but there are significant indications as to the success of our program. We have been successful in placing our Ph.D. and M.S. graduates into science, industrial and teaching positions. For example, all Ph.D. graduates (20 so far) from Bill Tong's Lab (Analytical Chemistry) received job offers (multiple offers in many cases) before they defend their Ph.D. dissertation from a wide range of companies and universities including UCSD, USD and Arizona State (for teaching positions) and Proctor and Gamble, Roche, Pfizer, Illumina, Amylin, Beckman, etc. The Tong Lab Masters graduates also received job offers before they defend their theses. Another lab (Tom Huxford, Biochemistry) has had Masters graduates accept science positions at Siemens Healthcare in Los Angeles (Danny Trinh), Novartis Pharmaceuticals in Emeryville, CA (Jacob Shaul), Isis Pharmaceuticals in San Diego (Michaela Norrbom), Lpath, Inc. in San Diego (Jon Fleming), Aalto Scientific in Carlsbad, CA (Jesal Patel), The Geoff Chang Lab, Skaggs School of Pharmacy in La Jolla, CA (Mark Villaluz), Axikin Pharmaceuticals in San Diego (Danielle DiTirro), and Sapient Discovery in San Diego (Deepthi Anipindi). Ashlee King, the most recent chemistry student to graduate with her M.S. degree from the Huxford Lab, was recruited to join the research team at Lpath, Inc., prior to her graduation on the basis of the strength of our program to prepare students as contributing members of a laboratory research team.

Many of our faculty members can share stories of being approached by local companies who are looking specifically to hire recent SDSU Chemistry Masters or Ph.D. graduates. The employers often comment on how well prepared our SDSU Chemistry M.S. and B.S. graduates are to perform hands-on bench work and how they have extensive research experience as compared to graduates from other universities. Although this evidence is only anecdotal, we believe that our intensive focus on laboratory experiences as an integral part of our course offerings and the requirement of independent laboratory research projects from both our undergraduate majors and M.S. candidates is behind this perception.

Major Facilities

The Department of Chemistry and Biochemistry is housed primarily in the Chemical Sciences Laboratory Building, which provides more than 40,000 sq. ft. of state-of-the-art laboratory and office space. Specific equipment and other facilities of note are described below.

SDSU Chemistry NMR Facility

The department has three Varian VNMRS nuclear magnetic resonance (NMR) spectrometers:
VNMRS 600 MHz, installed in Spring 2007, and generally dedicated to biomolecular studies;
INOVA 500 MHz, allocated for specialized work such as variable-temperature and kinetics studies;
VNMRS 400 MHz, installed in Fall 2006, the workhorse machine for all synthetic chemists in the department, equipped with a sample changer for overnight use.

A complement of probes provides the ability to observe the resonances of ^{1}H, ^{19}F and all nuclei with resonance frequencies between ^{31}P and ^{15}N. These probes can perform all modern one- and multi-dimensional experiments that are essential for chemical research. All of the spectrometers are capable of indirect detection and are equipped with pulsed-field gradients. The 500 and 400 MHz spectrometers have automated dual broadband probes (^{1}H-^{19}F/^{15}N-^{31}P) that can be automatically tuned for any nucleus in these ranges and for any solvent. The 600 and 500 MHz spectrometers have three channel (^{1}H/^{13}C/^{15}N) probes. The 500 MHz spectrometer has a probe for triple or quadruple resonance work, capable of simultaneous or single irradiation of ^{13}C, ^{15}N, and ^{31}P frequencies. All probes have variable temperature capability. The spectrometers are being networked, allowing data to be remotely processed. Students routinely acquire data on the 400 MHz spectrometers. In addition to meeting the educational and research needs of the university, the NMR facility provides analytical services for industry and other educational institutions. Dr. LeRoy Lafferty is a full-time administrator of our NMR facility.

SDSU Chemistry X-Ray Diffractometer

The department is well-equipped for both small molecule and macromolecular structure determinations. Small molecule work is carried out on a Bruker X8 APEX X-Ray Diffractometer featuring:

- Bruker's highest sensitivity (170 electrons/Mo photon) CCD detector and an extremely fast readout rate (0.3 sec at 512^2 resolution)
- a short beam path for high intensity
- the Kappa goniostat geometry
- comprehensive control and structure determination software.

This diffractometer is housed in the Chemical Sciences Laboratory Building and serves the structure determination needs of research groups in organic and organometallic synthesis.

Our Macromolecular X-ray Crystallography Facility consists of:

- Rigaku RU-H3R 18 kW rotating-anode x-ray generator
- R-Axis IV++ image plate detector

- Osmic Blue x-ray optics system
- Oxford Cryosystems 700 Series Cryostream cryostat
- Inverse phi sample mounting goniometer

The 300 mm x 300 mm detector aperture offers high spatial resolution, capable of remarkably low background noise compared to CCD detectors, allowing a dynamic range of nearly six orders of magnitude. The use of dual plates permits the instrument to acquire exposures and read out data simultaneously.

SDSU Chemistry Mass Spectrometry Facility

This lab houses several GC-MS and two LC-MS systems, available for highly precise quantitative and qualitative analysis of complex samples. Among other projects, these systems are presently engaged in a long-term study of effects of tobacco smoke in association with the SDSU School of Public Health.

SDSU Chemistry Machine Shop

The Department of Chemistry and Biochemistry Machine Shop occupies about 1600 sq. feet of space and is equipped with two mills, a 13-inch lathe, drill press, 22-inch bandsaw, horizontal bandsaw, and numerous sheet metal and wood-working tools. An extensive metal stock is available. The space is also used for the repair and maintenance of our many vacuum pumps.

Molecular Sciences Computer Cluster

The computer cluster Dugong, purchased through NSF and Army Research Office grants awarded to the department in 2010, is dedicated to research projects in the molecular sciences. Dugong is a combination of high-performance nodes (13 nodes totaling 26 Intel X5680 3.3 GHz processors, 156 cores, 624 GB RAM) and parallel-processing nodes (7 nodes totaling 28 AMD 6134 2.3 GHz processors, 224 cores, 448 GB RAM). Installed software includes Gaussian 09, Gamess, MolPro, and PWSCF.

Lasers and Other Instruments

We also have three FT-IRs, Raman spectrometers, fluorescence spectrometers, many UV-visible spectrometers, and major instruments for electrochemistry. The department also has some inert-atmosphere glove boxes for conducting research on air- and moisture-sensitive compounds. The departmental computer lab has 25 personal computers (Mac and PC) for general use, and numerous research-grade computers are housed in individual laboratories. Access is also available to accounts at the San Diego Supercomputer Center.

Individual research groups have a wide range of major instruments. For example, Prof. Bill Tong has installed many major laser systems (~$2M replacement cost) needed for nonlinear laser spectroscopy and a high-resolution mass spectrometer (Nu 1700 ICP-MS, $1.4M). Major instruments (funded by NIH, NSF, etc.) available in the Tong Lab include mid-IR tunable solid-state mode-hop-free quantum cascade lasers, three external-cavity tunable diode lasers, several solid-state lasers covering wavelengths from UV to IR, a ring dye laser (single-frequency,

actively frequency stabilized, 400 kHz bandwidth), three high-power argon ion lasers, three Nd:YAG pulsed lasers (800 mJ at 1064 nm, with optics for 532 nm, 355 nm and 266 nm), a pulsed dye laser (Lambda-Physik LPD 3002E, with 0.04 cm^{-1} or 0.0007 nm linewidths), a pulsed dye laser (Lambda-Physik Scanmate2), a pulsed dye laser (Quantel), four excimer pulsed lasers (400 mJ at 249 nm), a pulsed dye laser (Lumonics, with 0.08 cm^{-1} or 0.0014 nm line width at 420 nm), a carbon dioxide laser (5 J at 10.6 μm), two wavemeters (0.01 cm^{-1} accuracy), three inductively coupled plasma atomizers (ICP, ICP-OES and ICP-MS), a graphite furnace atomic spectrophotometer, liquid chromatographs, Beckman P/ACE capillary electrophoresis (CE) systems, several custom-built CE systems, and seven vibration-isolated large laser optical tables.

Appendix 18 - Memoranda of Understanding from Partner Insitutions

Cooperative Agreement By and Between
San Diego State University
San Diego, CA
AND
Georgian Technical University
Tbilisi, GEORGIA

The provisions recorded below establish the principles and conditions by which San Diego State University(SDSU) and Georgian Technical University agree to cooperate in academic exchanges, program development andresearch. Such a cooperative agreement will be realized as established in the following clauses:

I. Legal framework of both universities

Georgian Technical University is empowered by its bylaws to enter into cooperative agreements of this naturewith other universities in regardto the subjects related to the achievement of its goals and objectives,as stated in its bylaws, in order to further contribute to the achievement of such goals and objectives.

SDSU is one ofthe 23 universities of the California State University system. Operating under theauthority ofTitle 5 of the California Administrative Code, the president of the campus may initiateagreements with foreign institutions of higher education to enhance international good will andunderstanding through programs of academic exchange.

II. SDSU and Georgian Technical University common interests and objectives

By reason of their very essence as universities, SDSU and Georgian Technical University share interests andobjectives in academic exchange and scientific research matters. Both institutions are interested in establishing academic cooperation agreements with institutions of similar nature In order to assist inthe achievement of their goals and objectives in such matters.

III. Purpose of the Agreement

SDSU and Georgian Technical University jointly agree to subscribe to a cooperative agreement in order topromote the following activities between both universities:

a. Cooperative development of courses and academic programs
b. Development of joint scientific and/or technological research projects
c. Exchange of students
d. Exchange of teaching and research personnel
e. Any other activity of mutual interest regarding academic or scientific and technological research matters

IV. Execution of the Agreement

Appendix 18 - Memoranda of Understanding from Partner Insitutions

The specific activities to be carried out under this agreement will be stated in corresponding specific sub-agreements. Such specific sub-agreements, once approved by both parties, will be attached as annexes to this agreement.

V. Specific Sub-Agreements

The specific sub-agreements between both universities will specify their objectives, conditions and ways of execution, financial support, term of validity, and administrative responsibility within each institution.

VI. Term and Termination

This agreement will be effective on the date It has been signed by both parties, and it will be In effect for a period of three (3) years. The agreement can be renewed for additional three (3) year periods by mutual consent of the parties to the agreement. Both parties reserve the right to terminate this agreement upon written notice given six months prior to the termination date becoming effective.

VII. Coordination and Follow-up

Administration of the Cooperative Agreement shall be the responsibility of the Assistant Vice President for International Programs at SDSU and the Rector Archil Prangishvili of Georgian Technical University, or his designee. Any additions, changes, or deletions must be approved by these representatives of both universities. All notices shall be in writing and shall be directed to these Individuals as follows:

TO SDSU:

Office of International Programs
San Diego State University
5500 Campanile Drive
San Diego, CA 92182-5102, USA
Email: oip@mail.sdsu.edu

TO GEORGIAN TECHNICAL UNIVERSITY:

Archil Prangishvili
Rector, Georgian Technical University
Administrative Building 77
Kostava STr., 0175
Tbilisi, GEORGIA

For San Diego State University

Dr. Eliot Hirshman
President

Date:

For Georgian Technical University

Dr. Archil Prangishvili
Rector

Date:

GEORGIAN TECHNICAL UNIVERSITY • LEPL • 211349192 •

COOPERATIVE AGREEMENT BY AND BETWEEN
SAN DIEGO STATE UNIVERSITY
San Diego, California
AND
Ilia State University
Tbilisi, GEORGIA

The provisions recorded below establish the principles and conditions by which San Diego State University (SDSU) and Ilia State University agree to cooperate in academic exchanges, program development and research. Such a cooperative agreement will be realized as established in the following clauses:

I. Legal framework of both universities

Ilia State University is empowered by its bylaws to enter into cooperative agreements of this nature with other universities in regard to the subjects related to the achievement of its goals and objectives, as stated in its bylaws, in order to further contribute to the achievement of such goals and objectives.

SDSU is one of the 23 universities of the California State University system. Operating under the authority of Title 5 of the California Administrative Code, the president of the campus may initiate agreements with foreign institutions of higher education to enhance international good will and understanding through programs of academic exchange.

II. SDSU and Ilia State University common interests and objectives

By reason of their very essence as universities, SDSU and Ilia State University share interests and objectives in academic exchange and scientific research matters. Both institutions are interested in establishing academic cooperation agreements with institutions of similar nature in order to assist in the achievement of their goals and objectives in such matters.

III. Purpose of the Agreement

SDSU and Ilia State University jointly agree to subscribe to a cooperative agreement in order to promote the following activities between both universities:

A) Cooperative development of courses and academic programs
B) Development of joint scientific and/or technological research projects
C) Exchange of students
D) Exchange of teaching and research personnel
E) Any other activity of mutual interest regarding academic or scientific and technological research matters

IV. Execution of the Agreement

The specific activities to be carried out under this agreement will be stated in corresponding specific sub-agreements. Such specific sub-agreements, once approved by both parties, will be attached as annexes to this agreement.

V. Specific Sub-Agreements

The specific sub-agreements between both universities will specify their objectives, conditions and ways of execution, financial support, term of validity, and administrative responsibility within each institution.

VI. Term and Termination

This agreement will be effective on the date it has been signed by both parties, and it will be in effect for a period of three (3) years. The agreement can be renewed for additional three (3) year periods by mutual consent of the parties to the agreement. Both parties reserve the right to terminate this agreement upon written notice given six months prior to the termination date becoming effective.

VII. Coordination and Follow-up

Administration of the Cooperative Agreement shall be the responsibility of the Assistant Vice President for International Programs at SDSU and the Rector Gigi Tevzadze of Ilia State University, or his designee. Any additions, changes, or deletions must be approved by these representatives of both universities. All notices shall be in writing and shall be directed to these individuals as follows:

TO SDSU:

Office of International Programs
San Diego State University
5500 Campanile Drive
San Diego, CA 92182-5102, USA.
E mail: oip@mail.sdsu.edu

TO Ilia State University:

Prof. Gigi Tevzadze
Rector, Ilia State University
3/5 K. Cholokashvili Ave
Tbilisi, 0162, GEORGIA
Email : gigi@iliauni.edu.ge

For San Diego State University

Dr. Elliot Hirshman
President

Date: _____

For Ilia State University

Dr. Gigi Tevzadze
Rector

Date: 02 03 2013

COOPERATIVE AGREEMENT BY AND BETWEEN
SAN DIEGO STATE UNIVERSITY
San Diego, CALIFORNIA
AND
IVANE JAVAKHISHVILI TBILISI UNIVERSITY
Tbilisi, GEORGIA

The provisions recorded below establish the principles and conditions by which San Diego State University (SDSU) and Ivane Javakhishvili Tbilisi University agree to cooperate in academic exchanges, program development and research. Such a cooperative agreement will be realized as established in the following clauses:

1. Legal framework of both universities

Ivane Javakhishvili Tbilisi University is empowered by its bylaws to enter into cooperative agreements of this nature with other universities in regard to the subjects related to achievement of its goals and objectives, as stated in its bylaws, in order to further contribute to the achievement of such goals and objectives.

SDSU is one of the 23 universities of the California State University system. Operating under the authority of Title 5 of the California Administrative Code, the President of the campus may initiate agreements with foreign institutions of higher education to enhance international good will and understanding through programs of academic exchange.

2. SDSU and Ivane Javakhishvili Tbilisi University common interests and objectives

By reason of their very essence as universities, SDSU and Ivane Javakhishvili Tbilisi University share interests and objectives in academic exchange and scientific research matters. Both institutions are interested in establishing academic cooperation agreements with institutions of similar nature in order to assist in the achievement of their goals and objectives in such matters.

3. Purpose of the Agreement

SDSU and Ivane Javakhishvili Tbilisi University jointly agree to subscribe to a cooperative agreement in order to promote the following activities between both universities:

A) Cooperative development of courses and academic programs
B) Development of joint scientific and/or technological research projects
C) Exchange of students
D) Exchange of teaching and research personnel
E) Any other activity of mutual interest regarding academic or scientific and technological research matters.

4. Execution of the Agreement

The specific activities to be carried out under this agreement will be state in corresponding specific sub-agreements. Such specific sub-agreements, once approved by both parties, will be attached as annexes to this agreement.

5. Specific Sub-Agreements

The specific sub-agreements between both universities will specify their objectives, conditions and ways of execution, financial support, term of validity, and administrative responsibility within each institution.

6. Term and Termination

This agreement will be effective on the date it has been signed by both parties, and it will be in effect for a period of three (3) years. The agreement can be renewed for additional three (3) year periods by mutual consent of the parties to the agreement. Both parties reserve the right to terminate this agreement upon written notice given six months prior to the termination date becoming effective.

7. Coordination and Follow-up

Administration of the Cooperative Agreement shall be the responsibility of the Assistant Vice President for International Program at SDSU and the Rector Alexander Kvitashvili of Ivane Javakhishvili Tbilisi University, or his designee. Any additions, changes, or deletions must be approved by these representatives of both universities. All notices shall be in writing and shall be directed to these individual as follow:

To SDSU:

Office of International Programs
San Diego State University
5500 Campanile Drive
San Diego, CA 92182-5102, USA.
E-mail:oip@mail.sdsu.edu

To Ivane Javakhishvili Tbilisi University:

Prof. Alexander Kvitashvili
Rector, Ivane Javakhishvili Tbilisi University
1, Ilia Chavchavdze Ave., Tbilisi, 0179, Georgia
E-mail: sandro.kvitashvili@tsu.ge

For San Diego State University

Dr. Elliot Hirshman
President

Date: _____

For Ivane Javakhishvili Tbilisi University

Dr. Alexander Kvitashvili
Rector

Date: 15 March 2013

COOPERATIVE AGREEMENT BY AND BETWEEN SAN DIEGO STATE UNIVERSITY
San Diego, CALIFORNIA
AND
G. ELIAVA INSTITUTE OF BACTERIOPHAGES, MICROBIOLOGY AND VIROLOGY
Tbilisi, GEORGIA

The provisions recorded below establish the principles and conditions by which San Diego State University (SDSU) and G. Eliava Institute of Bacteriophages, Microbiology and Virology (Eliava Institute) agree to cooperate in academic exchanges, program development and research. Such a cooperative agreement will be realized as established in the following clauses:

1. Legal framework of both institutions

G. Eliava Institute of Bacteriophages, Microbiology and Virology is empowered by its bylaws to enter into cooperative agreements of this nature with other institutes and universities in regard to the subjects related to achievement of its goals and objectives, as stated in its bylaws, in order to further contribute to the achievement of such goals and objectives.

SDSU is one of the 23 universities of the California State University system. Operating under the authority of Title 5 of the California Administrative Code, the President of the campus may initiate agreements with foreign institutions of higher education to enhance international good will and understanding through programs of academic exchange.

2. SDSU and the Eliava Institute common interests and objectives

SDSU and Eliava Institute share interests and objectives in academic exchange and scientific research matters. Both institutions are interested in establishing academic cooperation agreements with institutions of similar nature in order to assist in the achievement of their goals and objectives in such matters.

3. Purpose of the Agreement

SDSU and Eliava Institute jointly agree to subscribe to a cooperative agreement in order to promote the following activities between both parties:

A) Development of joint scientific opportunities, technological developments, or research projects
B) Opportunities for student training and participation in technological or research projects
C) Exchange of teaching and research personnel
D) Any other activity of mutual interest regarding academic or scientific and technological research matters.

4. Execution of the Agreement

Any specific activities to be carried out under this agreement will be stated in corresponding specific sub-agreements. Such specific sub-agreements, once approved by both parties, will be attached as annexes to this agreement.

5. Specific Sub-Agreements

The specific sub-agreements between both parties will specify their objectives, conditions and ways of execution, financial support, term of validity, and administrative responsibility within each institution.

6. Term and Termination

This agreement will be effective on the date it has been signed by both parties, and it will be in effect for a period of three (3) years. The agreement can be renewed for additional three (3) year periods by mutual consent of the parties to the agreement. Both parties reserve the right to terminate this agreement upon written notice given six months prior to the termination date becoming effective.

7. Coordination and Follow-up

Administration of the Cooperative Agreement shall be the responsibility of the Assistant Vice President for International Programs at SDSU and the Ambassador Revaz Adamia, Director of the G. Eliava Institute of Bacteriophages, Microbiology and Virology, or his designee. Any additions, changes, or deletions must be approved by these representatives of both institutions. All notices shall be in writing and shall be directed to these individual as follow:

To SDSU:
Office of International Programs
San Diego State University
5500 Campanile Drive
San Diego, CA 92182-5102, USA.
E-mail:oip@mail.sdsu.edu

To Eliava Institute:
Ambassador Revaz Adamia
Director, G. Eliava Institute of Bacteriophages,
Microbiology and Virology
3, Gotua Street, Tbilisi, 0160, Georgia
E-mail: adamia@pha.ge

For San Diego State University

Paul Wong
Dean, College of arts and Letters

Stanley Maloy
Dean, College of Sciences

Date: 3/20/13

For G. Eliava Institute of Bacteriophages,
Microbiology and Virology

Revaz Adamia
Director

Date: 15.03.2013

Research – Cooperate - Protect

SAN DIEGO STATE UNIVERSITY

Memorandum of Cooperation
Between
San Diego State University
and
Richard G. Lugar Center for Public Health Research

We the undersigned, **Richard G. Lugar Center for Public Health Research** (hereinafter referred to as **CPHR**) and **San Diego State University** (hereinafter referred to as **SDSU**), declare that sharing the common goals of development of viable and sound academic partnership in field of biological research, biosafety and biosecurity as well as creating education and training system based on the best international standards for the benefit of Georgia and the region, to agree on the following:

a. The **CPHR** and **SDSU** (hereinafter referred as **Parties**) make this **Memorandum on Cooperation** to coordinate and manage joint efforts in the field of biological research and education. The Memorandum represents general provisions and format for cooperation, while special schemes and agreements will be established for individual projects.

b. The **Parties** express confidence in their mutual interest to prepare and develop research proposals and teaching programs, which will ensure, on one hand, further strengthening of the research abilities of **SDSU** and on the other hand, will fulfill the scientific, research and teaching mission of the **CPHR**. The **Parties** agree to mobilize their intellectual, financial and technical resources as well as develop joint projects to be submitted to funding agencies..

c. The **Parties** will design joint activities annual action plan, its implementation schedule and designate a responsible person. **The Parties** will nominate shared staff for scientific collaborative activities.

d. The **Parties** will use intellectual resources / academic staff of the partners for curricula development, training materials preparation, academic review, institutional oversight (Institutional Biosafety Board, other) and other activities, which can contribute to institutional development of the parties.

e. **The Parties** will develop agreement(s) with regards to IP rights based on specificy and scope of individual projects. As a result of scientific cooperation between **the University** and **CPHR**, joint publications will be prepared and mentioning of all contributing parties is required in all presentation, publication or outreach materials (these include, but are not limited to, publications in peer-reviewed scientific journals and magazines, technical recommendations, teaching plans, web sites, and syllabi).

f. **The CPHR** express its readiness to provide access for the Parties to its intellectual and technical resources to carry out joint activities in the agreed areas of cooperation. Aiming at maintaining the effective security system the **CPHR's** management reserves the right, without any additional explanation to:

- restrict or deny access to the laboratory premises for any person from partner's side;
- reject, suspend or terminate planned or already started activity (project or element of the project);
- request strict observation of the Standard Operation Procedures (SOPs, internal regulations) of the CPHRL;
- establish project specific SOPs, which will be mandatory for implementation.

Any breach of these provisions or any of the SOPs shall be the ground for the revision or termination of the project or an element of the project; person(s) in committing the breach may be denied to access the laboratory's premises.

g. Memorandum will be automatically declared null and void on December 31, 2015.

h. Memorandum is in effect at the moment of signing by the representatives of all **Parties**.

i. Memorandum is completed in the Georgian and English languages. Copies in both languages are regarded as originals, but in case of ambiguities or misunderstandings the English version has the superior judicial power.

For the purposes of the present Memorandum of Cooperation, the representatives of **The Parties** are:

Anna Zhvania
Director
Richard G. Lugar Center
for Public Health Research
Kakheti Highway 3
0109 Tbilisi, GEORGIA
Tel: (+995) 2243 424
contact@cphr.ge
www.cphr.ge

Stanley Maloy, Ph.D.
Dean, College of Sciences
San Diego State University
5500 Campanile Drive
San Diego, CA 92182-1010 USA

George Kamkamidze, MD, Ph.D, MS
Head of Laboratories
Richard G. Lugar Center
for Public Health Research
Kakheti Highway 3
0109 Tbilisi, GEORGIA
Tel: (+995) 2243 424

Date: 28 / 02 / 2013

Paul Wong, Ph.D.
Dean, College of Arts and Letters
San Diego State University
5500 Campanile Drive
San Diego, CA 92182-6060 USA

Date: 2 / 25 / 2013

კვლევა პარტნიორობა უსაფრთხოება

SAN DIEGO STATE UNIVERSITY

თანამშრომლობის მემორანდუმი
სან დიეგოს უნივერსიტეტსა და
რიჩარდ გ. ლუგარის საზოგადოებრივი ჯანმრთელობის კვლევით ცენტრს შორის

ჩვენ, ქვემოთ ხელის მომწერნი, რიჩარდ გ. ლუგარის საზოგადოებრივი ჯანმრთელობის კვლევითი ცენტრი და სან დიეგოს უნივეირსიტეტი თანახმა ვართ დავისახოთ საერთო მიზნები, განვავითაროთ სანდო სამეცნიერო პარტნიორობა ბიოუსაფრთხოებისა და ბიოლოგიურ კვლევებში. საქართველოსა და რეგიონის ინტერესებიდან გამომდინარე შევქმნათ საერთაშორისო სტანდარტებზე დაფუძნებული საგანმანათლებლო სისტემა. ჩვენ თანახმა ვართ:

ა. რიჩარდ გ. ლუგარის საზოგადოებრივი ჯანმრთელობის კვლევითი ცენტრი და სან დიეგოს უნვეირსიტეტი, ვდებთ ამ მემორანდუმს თანამშრომლობაზე, რომ საერთო ძალებით კოორდინირებას გავუწევთ, ბიოლოგიური კვლევებისა და განათლების განვითარებას. მემორანდუმი წარმოადგენს ურთიერთობის საერთო ფორმატს, სანამ ინდივიდუალური პროექტებისთვის მიღწეული იქნება კონკრეტული პროგრამები და შეთანხმებები.

ბ. მხარეები ნდობას უცხადებენ საერთო ინტერესს, ჩამოაყალიბონ, მოამზადონ და განავითარონ კვლევითი წინადადებები და სასწავლო პროგრამები, რომლებიც უზრუნველყოფილი იქნება, ერთის მხრივ, სან დიეგოს უნვიერსიტეტის მიერ, შემდგომი კვლევითი შესაძლებლობების გაძლიერებით და მეორეს მხრივ, რიჩარდ გ. ლუგარის საზოგადოებრივი ჯანმრთელობის კვლევითი ცენტრი შეასრულებს მეცნიერულ, კვლევით და სასწავლო მისიას. მხარეები თანხმდებიან მასზედ, რომ

მობილიზება გაუწიონ ინტელექტუალურ, ფინანსურ და ტექნიკურ შესაძლებლობებს და ასევე იმუშაონ საერთო პროექტებზე დონორებთან წარსადგენად.

გ. მხარეები შეთანხმდებიან დღეზე, როცა მოახდენენ წლის სამოქმედო გეგმის შედგენას, მისი განხორციელების გრაფიკს და დანიშნავენ პასუხისმგებელ პირს. ასევე მხარეები შეარჩევენ მუდმივ კადრებს საერთო სამეცნიერო აქტივობებისთვის.

დ. მხარეები გამოიყენებენ ინტელექტუალურ რესურსებს/ აკადემიურ პერსონალს სასწავლო პროგრამების განსავითარებლად, სატრენინგო მასალების მოსამზადებლად, აკადემიური მიმოხილვისთვის, ინსტიტუციური ზედამხედველობისა და სხვა აქტივობების შესამუშავებლად.

ე. მხარეებს აქვთ თანაბარი ინტელექტუალური საკუთრების უფლება ყოველ საერთო პროექტზე ან აქტივობაზე, თუ არ არსებობს სხვა ტიპის შეთანხმება. პროექტის სპეციფიკიდან გამომდინარე, მხარეებს შეუძლიათ შეიმუშაონ განსაკუთრებული ხასიათის შეთანხმებები ინტელექტუალური საკუთრების უფლებებზე. რიჩარდ გ. ლუგარის საზოგადოებრივი ჯანმრთელობის კვლევითი ცენტრისა და სან დიეგოს უნივერსიტეტისნ სამეცნიერო თანამშრომლობის შედეგად მომზადდება და გამოქვეყნდება ერთობლივი ნაშრომები, პრეზენტაციები, პუბლიკაციები (ეს მოიცავს, მაგრამ არ შემოიფარგლება მხოლოდ პუბლიკაციებით რეფერირებად სამეცნიერო ჟურნალებში, მეთოდური რეკომენდაციებით, სასწავლო გეგმებით, ტექნიკური რეკომენდაციებით, ვებგვერდებით, სილაბუსებით).

ვ. რიჩარდ გ. ლუგარის საზოგადოებრივი ჯანმრთელობის კვლევითი ცენტრი მზადაა შეთანხმების ფარგლებში, ხელი შეუწყოს მხარეებს ინტელექტუალური და ტექნიკური რესურსების რეალიზებაში.

ეფექტური, უსაფრთხო სისტემის შენარჩუნების მიზნით რიჩარდ გ. ლუგარის საზოგადოებრივი ჯანმრთელობის კვლევითი ცენტრი უფლებას იტოვებს ყოველგვარი ახსნა-განმარტების გარეშე:

- შეუზღუდოს ან აუკრძალოს პარტნიორი მხარის ყველა წარმომადგენელს ცენტრის ტერიტორიაზე შესვლა;
- უარი უთხრას, დროებით შეაჩეროს და შეწყვიტოს დაგეგმილი ან უკვე დაწყებული აქტივობა (პროექტი ან პროექტის ელემენტი);
- მოითხოვოს მკაცრი ზედამხედველობა, კონტროლი სტანდარტულ საოპერაციო პროცედურებზე (შიდა რეგულაციები, SOP-ები). რიჩარდ გ. ლუგარის საზოგადოებრივი ჯანმრთელობის კვლევითი ცენტრის მენეჯმენტს

უფლება აქვს შეიმუშაოს პროექტისთვის დამახასიათებელი SOP-ები, რომელთა დანერგვაც სავალდებულოა. SOP-ების დარღვევა გამოიწვევს პროექტის, ან მისი ელემენტის გადახედვას ან შეწყვეტას ან/და პროექტის იმ მონაწილეებს, რომლებიც დაარღვევენ არსებულ უსაფრხოების საოპერაციო პროცედურებს, შეუჩერდებათ ცენტრის ტერიტორიაზე შესვლის უფლება.

ზ. მემორანდუმი ავტომატურად დაკარგავს იურიდიულ ძალას 2015 წლის 31 დეკემბერი.

თ. მემორანდუმი იურიდიულ ძალას შეიძენს მხარეების წარმომადგენლების მიერ ხელმოწერისთვე.

ი. მემორანდუმი შედგენილია ქართულ და ინგლისურ ენებზე. ორივე ენაზე არსებული ასლები, განიხილება ორიგინალად, მაგრამ გაუგებრობის წარმოშობის შემთხვევაში უპირატესი იურიდიული ძალა მიენიჭება ქართულ ტექსტს.

მემორანდუმის მიზნებისათვის მხარეების წარმომადგენლები არიან:

ანა ჟვანია
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თარიღი: 28/02/2013

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თარიღი: 2/28/2013

COOPERATIVE AGREEMENT BY AND BETWEEN

SAN DIEGO STATE UNIVERSITY
San Diego, California
AND
TBILISI STATE MEDICAL UNIVERSITY
Tbilisi, Georgia

The provisions recorded below establish the principles and conditions by which San Diego State University (SDSU) and Tbilisi State Medical University (TSMU) agree to cooperate in academic exchanges, program development and research. Such a cooperative agreement will be realized as established in the following clauses:

I. Legal framework of both universities

TSMU is empowered by its bylaws to enter into cooperative agreements of this nature with other universities in regard to the subjects related to the achievement of its goals and objectives, as stated in its bylaws, in order to further contribute to the achievement of such goals and objectives.

SDSU is one of the 23 universities of the California State University system. Operating under the authority of Title 5 of the California Administrative Code, the president of the campus may initiate agreements with foreign institutions of higher education to enhance international good will and understanding through programs of academic exchange.

II. SDSU and TSMU common interests and objectives

By reason of their very essence as universities, SDSU and TSMU share interests and objectives in academic exchange and scientific research matters. Both institutions are interested in establishing academic cooperation agreements with institutions of similar nature in order to assist in the achievement of their goals and objectives in such matters.

III. Purpose of the Agreement

SDSU and TSMU jointly agree to subscribe to a cooperative agreement in order to promote the following activities between both universities:

A) Exchange of students
B) Exchange of teaching and research personnel
C) Cooperative development of courses and academic programs
D) Development of joint scientific and/or technological research projects
E) Any other activity of mutual interest regarding academic or scientific and technological research matters

IV. Execution of the Agreement

The specific activities to be carried out under this agreement will be stated in corresponding specific sub-agreements. Such specific sub-agreements, once approved by both parties, will be attached as annexes to this agreement.

V. Specific Sub-Agreements

The specific sub-agreements between both universities will specify their objectives, conditions and ways of execution, financial support, term of validity, and administrative responsibility within each institution.

VI. Term and Termination

This agreement will be effective on the date it has been signed by both parties, and it will be in effect for a period of three (3) years. The agreement can be renewed for additional three (3) year periods by mutual consent of the parties to the agreement. Both parties reserve the right to terminate this agreement upon written notice given six months prior to the termination date becoming effective.

VII. Coordination and Follow-up

Administration of the Cooperative Agreement shall be the responsibility of the Assistant Vice President for International Programs at SDSU and the person responsible at TSMU. Any additions, changes, or deletions must be approved by these representatives of both universities. All notices shall be in writing and shall be directed to these individuals as follows:

TO SDSU: Office of International Programs
San Diego State University
5500 Campanile Drive
San Diego, CA 92182-5102, USA.
E mail: oip@mail.sdsu.edu

TO TMSU: Tbilisi State Medical University
7 Mikheil Asatiani St,
Tbilisi, Georgia

APPROVED FOR SAN DIEGO STATE UNIVERSITY BY:

Nancy Marlin — 3 Oct 13
Nancy Marlin, Provost — Date

APPROVED FOR TBILISI STATE MEDICAL UNIVERSITY BY:

Rima Beriashvili — 3 Oct 13
Rima Beriashvili, Deputy Rector — Date

Kakhaber Chelidze, Dean — Date

Appendix 20 - Finalist Budget Detailed Laboratory Equipment Costs

	Budget for Labs for Electrical and Computer Engineering				
	Equipment for Labs 1 (covers courses EE 210L, EE 330L, EE430L)				
Qty	**Manufacturer**	**Model No.**	**Description**	**Mfr Suggested Retail/Base**	**Cost Per Seat**
1	Agilent	MSO-X 3014A	Mixed Signal Oscilloscope	$3,876	$3,876
1	Agilent	TDS3012	Digital Storage Scope	$5,160	$5,160
1	Agilent	N2791A	25MHz Differential Probe	$632	$632
1	Agilent	33210A	10 MHz Function/Arbitrary Waveform Generator	$1,279	$1,279
1	Tektronix	DMM4040	6-1/2 Digit Digital Multi Meter	$1,170	$1,170
1	Keithley	2200-60-2	Programable Power Supply	$1,110	$1,110
2	Agilent	34450A	Digital Multimeter with Display(2)	$787	$1,574
1	BK Precision		150W DC Electronic Load	$525	$525
1	Dell Precision		Desktop PC with Monitor	$2,500	$2,500
1	National Instruments	ELVIS II+	Desktop Development Station	$4,140	$4,140
2	Agilent	U8001A	Single output power supply(2)	$331	$662
1	Extech	380193	LCR Meter	$220	$110
1	Powerstat	501-C	Variac	$200	$100
				Total for each station	**$22,838**
	Number of stations	15	Cost for the lab equipment (not including furniture)		**$342,570**
	Equipment for Lab 2 (COMPE 270, CompE 335, CompE 470L)				
Qty	**Manufacturer**	**Model No.**	**Description**	**Mfr Suggested Retail/Base**	**Cost Per Seat**
1	Agilent	TDS3012	Digital Storage Scope	$5,160	$5,160
1	Tektronix	DMM 4040	6-1/2 Digit Digital multimeter	$1,170	$1,170
1	Agilent	33210A	10 MHz Function/Arbitrary Wave form Generator	$1,279	$1,279
1	National Instruments	Elvis II+	Desktop Development Station	$4,140	$4,140
1	Quanser	Motor control set	control board and motors	$9,000	$9,000
1	Dell Precision		Desktop PC with monitor	$2,500	$2,500
				Total per station	**$23,249**
	Number of stations	15	Cost of lab equipment (not including furniture and software)		**$348,735**
	Equipment for Lab #3 (Digital communication Lab)				
Qty	**Manufacturer**	**Model No.**	**Description**	**Mfr Suggested Retail/Base**	**Cost Per Seat**
1	Agilent	**DSO1022A**	200 MHz Digital Storage Oscilloscope	$1,854	$1,854
1	Emona Industries	TIMS-301C	Telecom's Signals Modeling Equipment	$13,200	$13,200
1	Dell Precision		Computer with monitor	$2,500	$2,500
1	Dell Precision		Computer with monitor	$2,500	$2,500
				Total per station	**$20,054**
	Number of stations	15	cost of lab equipment (not including furniture and software)		**$300,810**
	Equipment for Lab 4 : Antenna and Microwave Lab				
Qty	**Manufacturer**	**Model No.**	**Description**	**Mfr Suggested Retail/Base**	**Cost Per Seat**
1	Agilent	**E5071C**	Network Analyzer	$31,935	$31,935
1	HP		Plotter		$2,000
1	Agilent	**E5071C**	S-Parameter Test Set	$31,935	$31,935
1	Agilent	**E5071C**	S-Parameter Test Set	$31,935	$31,935
1	Various	**Small anachoid chamber**		$25,000	$25,000
1	Dell Precision	**PC with monitor**		$2,500	$2,500
				Total per Station	**$125,305**
	Number of stations	15	cost of lab equipment (not including furniture and software)		**$1,879,575**
	Equipment for Lab 5 : Senior Design Lab				
	All the equipment listed in Lab 1				**$22,838**
	Total per station				**$22,838**
	Number of stations	15	Cost of lab equipment (not including furniture)		**$342,570**
	Equipment for Lab 6: Power Electronics Lab				
Qty	**Manufacturer**	**Model No.**	**Description**	**Mfr Suggested Retail/Base**	**Cost Per Seat**
1	Agilent	TDS3012	Digital Storage Scope	$5,160	$5,160

1	Tektronix	DMM 4040	6-1/2 Digit Digital multimeter	$1,170	$1,170
1	Agilent	33210A	10 MHz Function/Arbitrary Wave form Generator	$1,279	$1,279
1	Energy conversion experiments			$2,000	$2,000
1	National Instruments	Elvis II+	Desktop Development Station	$4,140	$4,140
1	Special pupose power Electronics Board			$2,500	$2,500
1	Quanser		control board and motors	$9,000	$9,000
1	Dell Precision		Desktop PC with monitor	$2,500	$2,500
				Total for each seat	**$27,749**
	Number of stations	15	Cost of lab equipment (not including furniture and software)		**$416,235**

	Summary		**Equipment cost**	**Space requirements**	
				Square feet	
	Lab 1 (EE 210L, EE 330L, EE 430L)		$342,570	800	
	Lab 2 (CompE 270l, 375l,470l)		$348,735	800	
	Lab 3 (Digital communications)		$300,810	800	
	Lab 4 (Antenna and microwave)		1,879,575	800	
	Lab 5 Senior Design		$342,570	800	
	Lab 6 Power Systems		$416,235	800	
	Smart computer Room	30 computers	$75,000	1600	
	Space for Storage	Storing parts		500	
	Technician office			350	
	Electronic parts etc.		$50,000		
	Audio Video Equipment	In the labs	$40,000		
	Software costs	Recuring costs	$10,000		
	Furniture for the labs		$100,000		
	Totals		**$3,905,495**	**7250**	

SDSU-Georgia Chem/Biochem/Biotech Lab Cost Estimates in $k (Updated 2/2/14)

C100 Lab (1000SF)	
24/sec, 50 Fall, 18 Sp	
Locker x 12 x 1k	12
Hoods x 7 x 35k	245
Gas lines x 12 x 6k	72
Chem Supplies	5
Misc	4
Small Equip: Balances*	11
Remedial course by Georgian universities	
Total ($k)	**349**

C102 Lab (1000 SF)	
24/sec, 2 Fall, 5 Sp	
Locker x 12 x 1k	12
Hoods x 7 x 35k	245
Gas lines x 12 x 6k	72
Chem Supplies	12
Misellaneous	4
Small Equip: Balances, Spec-20, pH meters	48
This lab is needed only if nursing/med students are involved from the Tbilisi med school	
Total ($k)	**393**

C200/202 Lab (1000 SF)	
24/sec, 31 Fall, 27 Sp	
Locker x 12 x 1k	12
Hoods x 7 x 35k	245
Gas lines x 12 x 6k	72
Chem Supplies	14
Misc	4
Small Equip: Balances, pH meters, Explorer GLX. Red Tide Spec, Power Supply	86
Total ($k)	**433**

C201 Lab (1000 SF)	
24/sec, 12 Fall, 12 Sp	
Locker x 24 x 1k	24
Hoods x 7 x 35k	245
Gas lines x 12 x 6k	72
Chem Supplies	13
Misc	4
Small Equip: Balances, Spec-20, pH meters	60
Total ($k)	**418**

C232 Lab (1000 SF)	
20/sec, 9 Fall, 8 Sp	
Locker x 24 x 2k	48
Hoods x 25 x 35k	875
Gas lines x 12 x 6k	72
Chem Supplies	5
Misc	4
Small Equip: Heating mantle, power control, hot plate, thermometer, rotovap, oven	30
Total ($k)	**1,034**

C251 Lab (1000 SF)	
20/sec, 4 Sp	
Locker x 20 x 2k	40
Hoods x 7 x 35k	245
Gas lines x 12 x 6k	72
Chem Supplies	6
Misc	4
Small Equip: Balances, Spec-20, pH meters	8
Titrator x 2 x 2k	4
GC	8
UV-Vis Spec	7
Ultra Purify Sys	6
Ovens	5
Analytical balances	20
Total ($k)	**425**

C410A Lab (1000 SF)	
15/sec, 3 Fall	
Locker	
Hoods	
Gas lines	
Chem Supplies	
Small Equip	
Computers x 25 x 4k	100
Shared with C457	
Shared with EE CE	
Total ($k)	**100**

C432 Lab (1000 SF)	
20/sec, 6 Fall, 6 Sp	
Locker x 24 x 2k	48
Hoods x 25 x 35k	875
Gas lines x 12 x 6k	72
Chem Supplies	7
Small Equip: Heating mantle, power control, hot plate, thermometer	30
Rotovap	8
Oven	3
Total ($k)	**1,043**

C417 Lab (1000 SF)	
12/sec, 2 Sp	
Locker Shared	2
Hoods x 2 x 35k	70
Gas lines	
Chem Supplies	5
Small Equip: Balances, pH meter, heating mantle, magnetic stirrer, HeNe	12
Fluorometer	45
UV-vis spec x 2 x 15k	30
Nitrogen laser	25
Diff scanning calorimeter	20
Tensiometer	15
Raman spectrometer	30
IR spectrometer	25
NMR (see C457)	
Total ($k)	**279**

C567 Lab (1000 SF)	
15/sec, 1 Fall, 1 Sp	
Locker	12
Hoods	
Gas lines	
Chem Supplies	3
Small Equip: Balances, Spec-20, pH meters. Pipetman, light boxes, LC columns	35
PCR	20
Supercentrifuge x 3	120
Ultracentrifuge	99
Rotor centrifuge GSA x 2	12
Rotor centrifuge GSE x 2	12
Rotor, centrifuge, TV850	25
Rotor, centrifuge, TV865	25
UV-Vis Spec x 6	36
Fraction collector x 8	28
Centrifuge refrigerated table-top	20
Shaker refrigerated controlled temper	19
Photographic digital camera w/light bo	8
Incubator	3
Double-distilled generating system &	6
Tissue culture incubator	10
Tissue culture hood	16
Tissue culture microscope	10
Electrophoresis systems	40
Ultralow (-80C) freezer	15
Autoclave	55
Total ($k)	**629**

This C567 Lab will be located at GTU or split or preferably duplicated at both GTU and TSU

C457 Lab (1000 SF)	
15/sec, 3 Fall	
Locker Shared	5
Hoods	
Gas lines	
Chem Supplies	5
Small Equip: Balances, pH meter	10
HPLC x 4 x 50k	200
GC x 4 x 40k	160
UV-Vis x 2 x 15k	30
LCMS	100
GCMS	100
NMR	450
Lasers	35
O'scopes, Elec x 5	35
FTIR	40
Drying Oven	4
Balance x 4 x 2k	8
Desktop PCs x 4 x 3k	12
Raman spectrometer/microscope	90
Total ($k)	**1284**

C427 Lab (1000 SF)	
15/sec, 2 Sp	
Locker	21
Hoods	
Gas lines	
Chem Supplies	5
Small Equip: Heating mantle, power control, hot plate, thermometer	16
FTIR	30
Rotovap	8
Oven	3
NMR (see C457)	
UV-vis Spec	20
Magnetometer	10
Total ($k)	**113**

	Budget for Labs for Civil and Construction Engineering					
	Summary		**Equipment cost**	**Space requirements**		
				Square feet	**Notes**	
	Hydraulics Lab		$478,400	1000	25 seats	
	Structures Lab		$391,970	2000	25 seats	
	Geotechnical Lab		$161,840	1000	25 seats	
	Surveying Lab - Store equipment		$40,500	200	25 seats	
	Environmental Engineering Lab		$45,000		Additional equip in Chem lab	
	Smart computer Room	30 computers	$85,500	1600		
	Space for Storage			1000		
	Technician office			350		
	Audio Video Equipment	In the labs	$40,000			
	Software costs	Recuring costs	$22,000			
	Furniture for the labs		$100,000			
	Totals		**$1,365,210**	**7150**		
	Notes:					
	1. Since these prices change and does not include taxes and delivery charges					
	I would put the total at $1.5 Million dollars for the equipment					

Structures Lab							
						25 capacity	30 capacity
						391970	397980
LABS		EQUIPMENT NEEDED		NUMBER	COST	TOTAL	
Misc Lab ware		Pans, forms, gages, data acquisition, scales		LS	45000	45000	45000
Tensile strength		Universal Testing Machine		2	110000	220000	220000
Concrete Slump		Mixer		1	1900	1900	1900
		Slump kit with pan		6	125	750	1000
Concrete Beam		Tester		1	2800	2800	2800
Compression		Compression Machine		1	78000	78000	78000
		Cylinder Accessories		LS	11500	11500	11500
Unit Weight		Measures		4	155	620	930
		Strike Plates		4	75	300	450
Aggregate		LA Abrasion		1	6700	6700	6700
Specific Gravity		Bench Set		1	3200	3200	3200
Marshall		Test set		4	5300	21200	26500

Geotechnical Lab							
						25 capacity	30 capacity
						161840	198755
LABS		EQUIPMENT NEEDED		NUMBER	COST	TOTAL	
Misc Lab ware		Spoons, spatulas, racks, …		LS	10000	10000	10000
Soil Visual Classification		Glassware, bowls, pans		LS	2500	2500	2500
Atterberg Limits		Casagrande devices		6	425	2550	3400
		Plates		6	95	570	760
		Shrinkage Limit		3	110	330	440
Gradation		Shaker		1	1050	1050	1050
		Sieve sets with pan		6	920	5520	7360
		Scale		3	2750	8250	11000
Water content and void ratio		Oven		2	770	1540	1540
		Micrometers		2	255	510	765
Compaction		Molds		8	175	1400	1750
		Std Hammers		3	100	300	400
		Modified hammers		3	120	360	480
		Sand cone devices		8	245	1960	2450
Direct shear		Motorized dead weight mach		2	8300	16600	24900
		Boxes		5	600	3000	4200
		Weights		2	1200	2400	3600
		Sample prep		1	1800	1800	1800
		Data Acquisition		2	4500	9000	13500
Consolidation		Dead weight machines		4	1200	4800	6000
		Frames		4	350	1400	1750
		Weight sets		4	1200	4800	6000
		Fixed Ring cells		4	400	1600	2000
		Data acquistion		4	5200	20800	26000
Swell		Swell/expansion pods		5	560	2800	3920
		Swell pressure		2	3250	6500	9750
Permeability		CH permeameter set		4	720	2880	4320
Hydrometer		Mixer		1	500	500	500

		Hydrometers	4	250	1000	1500
Triaxial		Load frame	2	5760	11520	11520
		2 cell control panel	1	8450	8450	8450
		VC device	1	1600	1600	1600
		PP transducers and controller	1	6500	6500	6500
		De-airing chamber	1	1500	1500	1500
		Vacuum pump	1	800	800	800
		4 in cells	3	2250	6750	6750
		Prep, tubing, misc	1	8000	8000	8000

Hydraulics Lab							
						25 capacity	30 capacity
						478400	616200
LABS		EQUIPMENT NEEDED		NUMBER	COST	TOTAL	
Basic Bench		F1-10-B Basic Bench		3	8400	25200	33600
Flow over weirs, culvers, etc.		S16-10 Hydraulic Flow Demonstration		3	25300	75900	101200
Pipe Friction		C6-Mk11-10 Basic Fluid Friction Measurements		3	26300	78900	105200
Flow Meters		F1-21 Flow Meter Demonstration		3	7200	21600	28800
Bernoulli's Equation		F1-15 Bernoulli’s Theorem Demonstration		3	4500	13500	18000
Hydrographs		S-10 Rainfall Hydrographs		1	65000	65000	65000
Pipe Networks		C11-Mk 11 Pipe Networks		3	25300	75900	101200
Pumps		F1-27 Centrifugal Pump Characteristics		3	9900	29700	39600
Turbines		F1-25 Demonstration Pelton Turbine		3	13200	39600	52800
		F1-32 Demonstration Francis Turbine		3	12700	38100	50800
Misc Lab Equip		Extensions, pipe, flowmeters, etc		1	15000	15000	20000

Surveying Lab						
						25 capacity
						40500
LABS		EQUIPMENT NEEDED		NUMBER	COST	TOTAL
Misc Lab ware		Tripods, rods, prisms, chains		LS	4500	4500
Total station w/auto level		Instruments		4	9000	36000

SAUNDERS GROUP
Infrastructure Consultants

Engineers Independent Inspection Report

And Cost Estimates

Project Description:	**Tbilisi Higher Education Site Constructions and Refurbishments**
Produced For:	San Diego State University (SDSU) (Client)
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Approvals

	Name	Signature	Date
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TABLE OF CONTENTS

1. BACKGROUND AND PROJECT DETAILS

The SDSU are tendering to provide services for internationally accredited higher education facilities in Georgia. In this tender they are to provide proposal for the refurbishment works for approximately 29,750 sq.ft; and new construction for approximately 11,500 sq.ft. of teaching space. Both the rehabilitation and construction are to meet local and international standards for the education facilities and meet the MCC and IFC guidelines. The works are to be spread across three Universities; TSU, ISU and GTU.

The proposed rehabilitation works at TSU are for 24,900 sq.ft. of teaching spaces and involve Chemistry, Physics and Electrical Engineering Laboratories. There is also a requirement for lecture Halls and smart computer classrooms.

The proposed new construction works at ISU are for 11,500 sq.ft. of teaching spaces and involve Civil Engineering and Electrical Engineering Laboratories. There is also a requirement for associated public and administration areas. The ISU has already started on architectural designs for a proposed construction.

The proposed rehabilitation works at GTU are for 4850 sq.ft. of teaching spaces and involves Electrical Engineering Laboratories.

A detailed breakdown of the proposed spaces as proposed by SDSU can be found in Appendix D.

2. PURPOSE AND SCOPE

The purpose of this document is to report to the Client on the current situation in the identified refurbishment sites the new construction and to advice on a preliminary cost estimates for the same. The scope of works is limited to reporting on the findings of site inspection, making comment and recommendations on the inspected conditions, relative to the local market and providing provisional cost estimates.

3. TERMS & DEFINITIONS

Specific terms and definitions used in this report are as follows

SDSU – San Diego State University (Client)

TSU – Tbilisi State University

ISU – Ilia State University

MCC – Millennium Challenge Corporation

IFC – International Finance Corporation (World Bank)

4. METHODOLOGY

The sites are to be visited to document the current situation of existing spaces. Any potential challenges or obstacles are to be noted. Cost estimates are to be prepared with consideration for the requirements of SDSU and local market rates. Local market rates for construction are in USD/m2 so estimations will be presented in this format.

5. INTERNATIONAL PERFORMANCE STANDARDS

The construction and refurbishment should comply with all local municipality regulations and also take into consideration local and international standards and industry best practice guidelines.

The project is to comply with MCC guidelines. The proposed works are most probably to be classified as Category C, as the project is unlikely to have adverse environmental and social impacts. While MCC generally will not require environmental and social impact analysis for a Category C project, MCC reserves the right to require specific environmental and social impact studies, reporting, or training where relevant or where positive environmental and social impacts may be enhanced.

The Client has requested the works are in compliance with the IFC performance standards.

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
- Performance Standard 2: Labor and Working Conditions
- Performance Standard 3: Resource Efficiency and Pollution Prevention
- Performance Standard 4: Community Health, Safety, and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage

The proposed works will impact on 1-4 and 8 performance standards to some degree. Any proposed works should be assessed relative to these performance standards and a report created on how these performance standards are to be met to best avoid, mitigate, and manage risks and impacts and to run the project in a sustainable way and to benefit all the stakeholders.

6. TSU SITE VISITS

6.1. TSU Site Visit Details

A site visit to TSU was carried out on the 17/01/2014. Various spaces were inspected at two campuses; the campus on 3 Chachavadze Street and the campus at University Street. Pictures from the site inspection are located in Appendix A. The buildings appeared to have generally adequate spaces available for the proposed usage, however some chopping and changing of spaces would be required.

6.2. Fittings, Floors, Walls and Ceilings

The doors and windows were generally functioning and the majority were well used. There was some newly installed double glazed windows. The floor, wall and ceilings were all very tired in the inspected spaces. There was noted some water damage, it is not clear where this has originated from or the actual extent of this damage.

6.3. Air Conditioning and Ventilation

The majority of spaces were heated by a central gas heating system, presumed to be running a water circulation and internal radiation heater system. Cooling is limited to high wall split air-conditioning systems and these are generally confined to office administration spaces but not laboratories or teaching spaces. Most spaces have operable external windows and did not have forced mechanical ventilation.

6.4. Building Insulation

The buildings appear to be solid concrete wall construction, which typically has relatively poor thermal insulation properties. The windows were a mixture of older double pane, old single pain and some recently installed double glazed.

6.5. Lighting

Lighting was limited in some areas, however as the sites were inspected during the day the natural lighting appeared adequate. Some refurbished locations had lighting on motion detector power saving systems.

6.6. Acoustics

The rooms are generally concrete wall with hard floor and ceiling materials resulting in high reverberation levels.

6.7. Fire and Emergency

Emergency exit plans and some fire extinguishers in common spaces were noticed. The free path was obstructed by some fixed doors, however these were open at the time of inspection. No fire detection or alarm systems were noticed

6.8. Electrical

Electrical wiring and switchboards were exposed in many places and presented a hazard, switchboards the same. The Tbilisi power system has had disruptions and surges in the past, UPS or surge protection was not noticed.

6.9. Gas

None of the facilities had operating chemistry lab gas systems. It was reported this lack of gas supply was from soviet era where there were problems in gas supply and they switched to electrical chemical heating systems. It was reported there is boundary connection point for gas, as this is used for central heating.

6.1. Plumbing

Some of the spaces had plumbing, general condition was poor with leaky taps, exposed piping and generally tired installations.

6.2. Structural

The building structure was mostly concrete with some structural steel columns noticed. The building on Chachavadze Street had some brick and mortar walls. What appeared to be structural cracks in the concrete were noticed in a number of areas.

6.3. Chemical Hoods

Some chemistry hoods were inspected, these looked well used and were reported to be functioning.

6.4. Facilities Plant room

Plant rooms were not inspected. The location of central heating plant was not discussed, it is presumed these would be on a separate building for central heating systems and possibly on the roof and walls of buildings for any other HVAC equipment.

6.1. Toilets and Kitchens

Toilet areas or kitchens were not inspected, it would be assumed these were in a tired condition.

6.2. Completed refurbishment Example

An example of completed refurbishments as inspected is attached in Appendix A. It was reported that the average cost for this refurbishment works was 100 USD/m^2.

7. GTU SITE VISIT

7.1. GTU Site Visit Details

A site visit to GTU was carried out on the 20/01/2014. The building which was inspected was located at the GTU campus on Merab Kostava Street. Pictures from this site inspection can be seen in Appendix B. The building was newer than the buildings visited at TSU.

Spaces were presented which would meet the requirements for the proposed spaces, some walls may need to be removed to achieve the class sizes. Internal refurbishment work had been recently completed on some parts of this building as shown in Appendix B. Most of the comments from TSU site visit would be relevant here, although the structure of building appeared to be reinforced concrete and appeared newer and in better condition.

8. ISU SITE VISIT

The ISU site on Chokolashvili Street opposite Vake Park was visited on the 22/01/2014. The proposed building site was inspected and the Architects for the proposed construction were met to show the conceptual designs and discuss the proposed building functionality, plans and costs. The site pictures and Architectural render are included in Appendix C. The following was reported by the Architect:

- Geologist is investigating the site and making recommendations and working with engineers to determine the building foundation requirements.
- All utilities and infrastructure are available for this building including water supply, waste water, gas, electricity and campus central heating system.
- A basement is to be included all though this is not presented on the drawings.

- The top of building is to be a recreational area.
- Building service ducts are to be added and a plant room placed on roof. The building is to have all air conditioning and ventilation and all services required to function.
- Their estimated cost is $600/m^2 at 8000 m^2 = $ 4,800,000 'including everything' except furnishing.
- The base building would take approximately 8 months to construct.
- Constructing to three floors only with provision for higher floors in future as suggested by Client will cause major problems to the building and services design. For example the AC plant room is to be on roof, elevator is not so easily extended etc. It was recommended that entire building is constructed and required floors finished. With remaining building left as shell till further expansion is realized.

9. DISCUSSIONS AND RECOMMENDATIONS

9.1. Fittings, floors, walls and ceilings

The existing building fittings, floors, walls and ceilings require refurbishment to bring up to a reasonable level. External flashing and water tightness of building should be assessed and remedied at locations water damage is apparent. A suspended ceiling grid would be advised for concealing services, reduce acoustic reverberation and improve the general appearance of the space. It is recommended the walls be a combination of painted/GIB/wallpaper to suit and it is recommended the floor is re-laid or heavily refurbished in most areas. The new building should incorporate reasonable quality components that will last.

9.2. Air conditioning and ventilation

The existing central heating systems appeared effective on the sites visited. In the summer months in Tbilisi temperatures often get above 30°C, for teaching in these conditions an air conditioning (cooling) system would be advised. It should also be considered the university has summer break during Tbilisi's hottest months from approximately July to September.

Ventilation may become an issue in the cold winter months as windows remain closed to retain heat, some sort of adequate forced ventilation should be considered, particularly in the chemical laboratories. However given the lack of current mechanical ventilation systems and space to install these and to be cost conscious it is recommended the windows are continued to be used as ventilation for the refurbished working spaces.

For the new construction a central plant system with adequate ventilation systems and efficient heating/cooling methods should be incorporated.

9.3. Building Insulation

For existing buildings effective external insulation would improve the building efficiency and post construction insulation cladding methods are available, however this would be considered outside the scope for the existing buildings. Insulation and cladding would be recommended in any new constructions.

9.4. Lighting

The existing lighting systems require replacement in most instances to allow the space to be used after daylight hours, the condition of lighting is generally beyond refurbishment. New lighting should be on time clock or sensor energy conservation systems and incorporate efficient lighting methods.

9.5. Acoustics

The acoustic properties of the existing spaces are very live. It would be expected that the reverberation rates would exceed international standards for educational facilities. It is recommended this is improved by installing an acoustic tile in the suspended ceiling and some soft furnishings, such as cushioned seats and possibly curtains. The lecture theatres should be assessed in this respect also. The new construction should also incorporate acoustic design philosophies.

9.6. Fire and Emergency

Fire systems in existing buildings would currently fall short of international fire standards for these spaces, redesign of entire building fire system is beyond this scope. A fire detection and alarm system should be installed at the minimum for the existing building renovations and fire suppression systems, and emergency exit lighting should be included in the new build.

Appropriate gas safety alarms should be installed in the chemical laboratories.

9.7. Electrical

Electrical wiring should be concealed and points and distribution appropriately rated for each spaces use. Surge protection should be considered for all spaces, particularly where high value equipment/instruments are to be used. Wifi internet network is understood to be functioning in most existing spaces. The new construction should incorporate modern communication and security systems.

9.8. Gas Supply

If gas connections are required in each chemistry class, the piping will have to be installed back to the building service connection. For the purposes of this cost estimate, electrical heating for chemistry is considered as installation of entire gas distribution system will disproportionately affect rates. The installation of a gas system can be estimated if required by the Client.

9.9. Structural

The existing older building structures are of concern, along with most of Tbilisi's building stock. Tbilisi's geological location is prone to seismic activity and it is questionable if the buildings are designed/constructed to sustain a significant seismic event. A proper structural assessment of the existing buildings would be advised.

9.10. Chemical Hoods

Due to the condition of existing hoods, it would be advised that all hoods be replaced with new.

9.11. Facilities Plant room

An accessible facilities plant room would be recommended if central HVAC systems are required in refurbishments. The creation of such space for existing buildings is currently considered outside the scope of works and is not included in cost estimates. The new building should have allocated space for this purpose.

9.12. Completed Refurbishment Examples

An example of some completed refurbishments as inspected are shown in Appendix A and B. It was reported that the average cost for refurbishment works was 100 USD/m^2 at TSU and 180 USD/m^2 at GTU. It was noted this was an acceptable, but basic quality and limited level of building services were provided.

9.1. ISU Architectural Designs

The Architectural designs presented are of reasonable standard for conceptual design. The cost estimates provided of $600 /$m^2$ would likely be reflective of a certain level of quality of design detailing, building components, and construction standards offered. Unfortunately the market has not developed to the level of a 'Registered' Architect, Structural Engineer or Building Services Designer; so it is difficult to assure the quality of a build. It would be recommended that any presented designs be Peer Reviewed, and an independent Construction Supervisor or Construction Manager engaged for quality assurance.

10. COST ESTIMATES

Cost can vary significantly depending on the Client specific requirements and accepted levels of quality. In line with IFC guidelines it is recommended that the new construction includes good quality components, green building concepts and energy efficient systems to ensure a long lasting sustainable building within reasonable budget constraints. The relative capital investment and construction cost is somewhat higher for these types of construction. The Georgian market is not developed in these aspects, so there may be resistance to higher cost. The balance between quality and cost is the Client's decision and can be adjusted if required.

The cost estimates have been prepared relative to the limited current scope definition. And should be taken as 'notional' costs. Should the project advance to conceptual stage a building construction task schedule and bill of quantities should be presented and then a more refined and accurate cost estimate can be realized. A full line price cost estimation or similar cost estimation method and cost planning, control and management is recommended by an independent and qualified quantity surveyor.

10.1. ISU Construction and Economies of scale

Due to economies of scale, costs would be expected to come down if more floors are being built. For example an elevator is a similar cost if it covers 3 floors as if it covers 8 floors. So the per meter cost here is significantly reduced for a bigger building, same goes for foundations, site works and roofs etc. The estimated square meter costs are for the Clients proposed building size only, it has been allowed as 3 floors (G, 1, 2) of the Architects presented conceptual design (Approx. 1873m^2 of working space), note that the ground floor is mostly atrium and courtyard access.

10.2. Contingency and Risks

Certain unknowns and building risks exist, particularly in the refurbishment, an example is the extent of water damage or structural damages to existing buildings which are difficult to assess from basic visual inspection. A cost contingency of 10% is included however the Client may consider adjusting this value.

10.3. Building Element Inclusions

Building elements have been broken into new items and refurbishment items costs, as the cost is inherently different to refurbish as to install complete new systems. The items have been grouped into the following categories and provisional estimates are listed in Appendix D:

- **Base-build** – Includes provisional estimate for the new construction site clearing, foundations, structure, floors, stairs, roofing, external windows, external doors and exterior walls, insulation and cladding.
- **Interior Fit-out –** Includes partitions, internal fittings and joinery, interior doors, internal walls, ceiling, and floor finishing.
- **Conveyance Systems** – Passenger elevators
- **Mechanical –** Plumbing and fixtures, water distribution and drainage, Gas distribution, Central heating/cooling systems (new), air distribution and exhaust systems (new), HVAC controls systems (new), commissioning and testing (new).
- **Fire Protection –** Fire and gas alarm systems for new building, fire suppression systems should be considered.
- **Electrical –** Includes power distribution boards, emergency power, lighting, specialty lighting, power fittings, communications, and security systems (new).
- **Site-work –** provisional sum for local landscaping, plants/trees, basic entrance and pathway.

10.4. Exclusions

The specific exclusions include:

- Excavation works for any below ground basement, significant site clearing, roadways, parking lots, pedestrian paving and site development including landscaping. Connections of services utilities and infrastructure beyond the building envelope.
- As requested by the Client the internal furnishings and laboratory equipment, for example the chemical gas hoods for chemistry laboratories are excluded.
- Gas systems for chemical laboratories have not been included in cost estimate as will require complete system installation and throw off costs here.

10.5. Professional Fees

The professional fees are based on current market rates, it is recommended reputable local Architect, Engineers and Construction Management /Supervisors are used to ensure a good quality outcome. The format of construction has not yet been specified (design-build etc.).

11. APPENDIX A – TSU SITE INSPECTION 17/01/2014

Figure 11-1: *TSU building on 3 Chachavadze Street.*

Figure 11-2*: Small classroom in Chachavadze building. Floors wall and ceiling are tired. Limited building services.*

Figure 11-3: *Example space of Approximately 150 m2 with 2 tier mezzanine floor at Chachavadze building, currently used as physics laboratory. The roof has some damage and the top tier of the overhung mezzanine has a distinct lean and what appears to be water damage raising structural concerns. Lights are missing and electrical wiring is old. Windows are also old two pane style.*

Figure 11-4: *Foyer stairwell in Chachavadze building. Note the electrical cabling is messy. The stairs have wheelchair ramps.*

Figure 11-5 *Chemical hoods in Chemistry Lab. Reported to be functioning.*

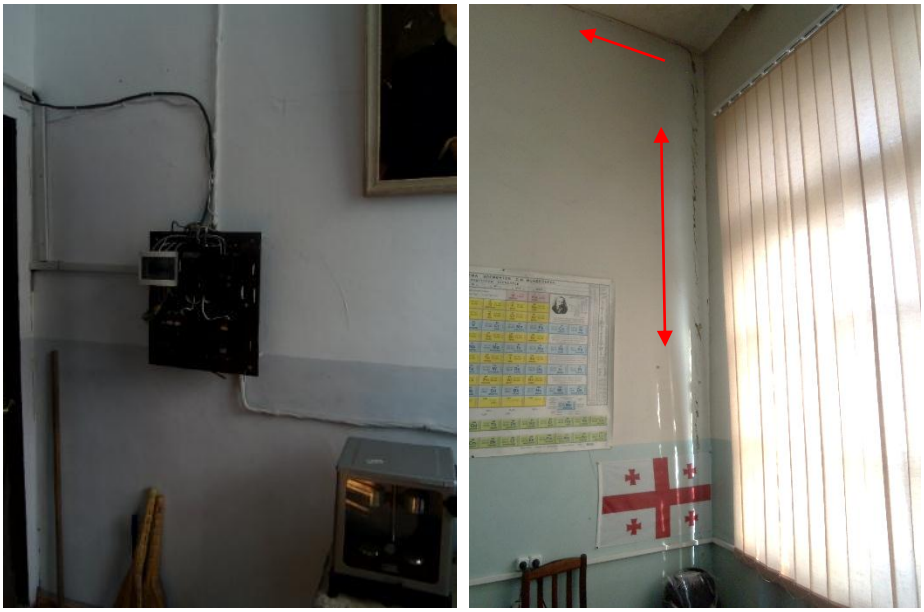

Figure 11-6 Above Right: *exposed circuit board in refurbished laboratory* ***Above Left:*** *structural crack in concrete running up wall and across ceiling*

Figure 11-7 *Lecture Theatre at Chachavadze Street Building. Functioning however generally tired space*

Figure 11-8 *Refurbished lecture theatre at University Street site, Suspended ceiling grid, painted walls and polyvinyl flooring along with new furnishings, windows not replaced.*

Figure 11-9 *Possible structural issues in a proposed space at University Street Building.*

12. APPENDIX B – GTU SITE INSPECTION 20/01/2014

Figure 12-1: *Building at Merab Kostava Street, proposed 1st, 5th, 8th and 9th floor for housing proposed spaces.*

Figure 12-2: *Space requiring refurbishment, note exposed electrical installation on left, all services to this space are tired and likely require refurbishment.*

***Figure 12-3**: Completed refurbishments on ground floor and 9th floor. The space in lower picture has been completed in association with Schneider to a higher standard of refurbishment and an associated higher cost. Note cable trunks and AC high-wall units.*

13. APPENDIX C - ISU SITE VISIT

***Figure 13-1**: Render of Architects proposed building design at ISU on Chokolashvili Street site.*

***Figure 13-2:** Current situation, view from proposed courtyard area (currently a car park) looking toward proposed building site.*

14. APPENDIX D – COST ESTIMATES

Please see attached the cost estimates spreadsheet in A3 paper size.

Appendix C - Laboratory and Classroom Space Requirements

Important : Must be read in conjunction with report

							Estimated USD construction cost per square meter							/Professional Fees			Sub Total Cost Estimates			
							Base building	Interior fitout	Conveyance	Mechanical	Fire	Electrical	Site	Architecture and IFC report	Structural and MEP designs	CM /Supervision	Construction	Professional	Combined	
						New	$ 400.00	$ 350.00	$ 125.00	$ 125.00	$ 10.00	$ 75.00	$ 10.00	$ 30.00	$ 25.00	$ 25.00	$ 1,095.00	$ 80.00	$ 1,175.00	/m2
Partner	Degree	# Spaces	Type	Total Sq Ft	*Total Sq m*	Notes (per space) Refurb	$ -	$ 100.00	$ -	$ 40.00	$ -	$ 40.00	$ -	$ 5.00	$ 3.00	$ 10.00	$ 180.00	$ 18.00	$ 198.00	/m2
TSU	Elec Eng	3	Electrical Engineering Labs	2400	*223*	15 Work Stations each lab; 800 sqft each	$ -	$ 22,296.73	$ -	$ 8,918.69	$ -	$ 8,918.69	$ -	$ 1,114.84	$ 668.90	$ 2,229.67				
	Chemistry	1	Chemistry & Gen Educ	1000	*93*	Power, Gas (12), Water, Vent (7 hoods), 24 Work Stations	$ -	$ 9,290.30	$ -	$ 3,716.12	$ -	$ 3,716.12	$ -	$ 464.52	$ 278.71	$ 929.03				
	Chemistry	1	Chemistry/Environ/Gen Educ	1000	*93*	Power, Gas (12), Water, Vent (7 hoods), 20 Work Stations	$ -	$ 9,290.30	$ -	$ 3,716.12	$ -	$ 3,716.12	$ -	$ 464.52	$ 278.71	$ 929.03				
	Chemistry	2	Chemistry 232 and 432	2000	*186*	Power, Gas (12), Water, Vent (25 hoods), 20 Work Stations	$ -	$ 18,580.61	$ -	$ 7,432.24	$ -	$ 7,432.24	$ -	$ 929.03	$ 557.42	$ 1,858.06				
	Chemistry	1	Chemistry 417/427/457	1000	*93*	Power, Gas (12), Water, Vent (2 hoods), 15 Work Stations	$ -	$ 9,290.30	$ -	$ 3,716.12	$ -	$ 3,716.12	$ -	$ 464.52	$ 278.71	$ 929.03				
	Chemistry	1	Chemistry 457 special	1000	*93*	Power, Gas, Water, Hoods (2), 15 work stations;	$ -	$ 9,290.30	$ -	$ 3,716.12	$ -	$ 3,716.12	$ -	$ 464.52	$ 278.71	$ 929.03				
	Chemistry	1	Chemistry 567	1000	*93*	Power, Gas (12), Water, Vent (25 hoods), 20 Work Stations	$ -	$ 9,290.30	$ -	$ 3,716.12	$ -	$ 3,716.12	$ -	$ 464.52	$ 278.71	$ 929.03				
	Physics	1	Gen Educ	1000	*93*	25 Work Stations	$ -	$ 9,290.30	$ -	$ 3,716.12	$ -	$ 3,716.12	$ -	$ 464.52	$ 278.71	$ 929.03				
	Elec Eng	2	Computer Labs	3200	*297*	30 Computer Stations each Lab	$ -	$ 29,728.97	$ -	$ 11,891.59	$ -	$ 11,891.59	$ -	$ 1,486.45	$ 891.87	$ 2,972.90				
	Elec Eng	2	Storeroom	1000	*93*	Electronic Parts and Supplies; Chemicals and Supplies	$ -	$ 9,290.30	$ -	$ 3,716.12	$ -	$ 3,716.12	$ -	$ 464.52	$ 278.71	$ 929.03				
	Elec Eng	2	Laboratory Office	700	*65*	Chemistry and Electrical Eng Lab Offices	$ -	$ 6,503.21	$ -	$ 2,601.29	$ -	$ 2,601.29	$ -	$ 325.16	$ 195.10	$ 650.32				
	Gen Educ	2	Lecture Hall	4800	*446*	Advanced Lecture Halls-Media Centers – 100 seats	$ -	$ 44,593.46	$ -	$ 17,837.38	$ -	$ 17,837.38	$ -	$ 2,229.67	$ 1,337.80	$ 4,459.35				
	Gen Educ	3	Smart/Computer Classrooms	4800	*446*	Smart/Computer Classrooms – 30 stations	$ -	$ 44,593.46	$ -	$ 17,837.38	$ -	$ 17,837.38	$ -	$ 2,229.67	$ 1,337.80	$ 4,459.35				
	GENERAL	*1*	*Comunal Areas/auditorium*	*5000*	*465*		*$ -*	*$ 46,451.52*	*$ -*	*$ 18,580.61*	*$ -*	*$ 18,580.61*	*$ -*	*$ 2,322.58*	*$ 1,393.55*	*$ 4,645.15*				
	GENERAL	*1*	*Toilets and facilities*	*3000*	*279*		*$ -*	*$ 27,870.91*	*$ -*	*$ 11,148.36*	*$ -*	*$ 11,148.36*	*$ -*	*$ 1,393.55*	*$ 836.13*	*$ 2,787.09*				
		24		**32900**	***3057***		**$ -**	**$ 305,651.00**	**$ -**	**$ 122,260.40**	**$ -**	**$ 122,260.40**	**$ -**	**$ 15,282.55**	**$ 9,169.53**	**$ 30,565.10**	**$ 550,171.80**	**$ 55,017.18**	**$ 605,188.98**	
ISU	Elec Eng	1	Electrical Enfineering Lab	800	*74*	15 Work Stations	$ 29,728.97	$ 26,012.85	$ 9,290.30	$ 9,290.30	$ 743.22	$ 5,574.18	$ 743.22	$ 2,229.67	$ 1,858.06	$ 1,858.06				
	Elec Eng	1	Antenna & Microwave Lab	800	*74*	15 Work Stations	$ 29,728.97	$ 26,012.85	$ 9,290.30	$ 9,290.30	$ 743.22	$ 5,574.18	$ 743.22	$ 2,229.67	$ 1,858.06	$ 1,858.06				
	Elec Eng	1	Senior Design Laboratory	800	*74*	15 Work Stations	$ 29,728.97	$ 26,012.85	$ 9,290.30	$ 9,290.30	$ 743.22	$ 5,574.18	$ 743.22	$ 2,229.67	$ 1,858.06	$ 1,858.06				
	Civ Eng	1	Hydraulics	1000	*93*	25 work stations	$ 37,161.22	$ 32,516.06	$ 11,612.88	$ 11,612.88	$ 929.03	$ 6,967.73	$ 929.03	$ 2,787.09	$ 2,322.58	$ 2,322.58				
	Civ Eng	1	Structural	2000	*186*	25 work stations	$ 74,322.43	$ 65,032.13	$ 23,225.76	$ 23,225.76	$ 1,858.06	$ 13,935.46	$ 1,858.06	$ 5,574.18	$ 4,645.15	$ 4,645.15				
	Civ Eng	1	Geotechnical	1000	*93*	25 work stations	$ 37,161.22	$ 32,516.06	$ 11,612.88	$ 11,612.88	$ 929.03	$ 6,967.73	$ 929.03	$ 2,787.09	$ 2,322.58	$ 2,322.58				
	Civ Eng	1	Surveying Lab	200	*19*	25 work stations	$ 7,432.24	$ 6,503.21	$ 2,322.58	$ 2,322.58	$ 185.81	$ 1,393.55	$ 185.81	$ 557.42	$ 464.52	$ 464.52				
	EE & CE	2	Computer Labs	3200	*297*	30 Computer Stations per lab	$ 118,915.89	$ 104,051.40	$ 37,161.22	$ 37,161.22	$ 2,972.90	$ 22,296.73	$ 2,972.90	$ 8,918.69	$ 7,432.24	$ 7,432.24				
	EE & CE	2	Storeroom	1000	*93*	Electronic Parts and Supplies	$ 37,161.22	$ 32,516.06	$ 11,612.88	$ 11,612.88	$ 929.03	$ 6,967.73	$ 929.03	$ 2,787.09	$ 2,322.58	$ 2,322.58				
	EE & CE	2	Laboratory Office	700	*65*	One each for EE and Civ/Con	$ 26,012.85	$ 22,761.24	$ 8,129.02	$ 8,129.02	$ 650.32	$ 4,877.41	$ 650.32	$ 1,950.96	$ 1,625.80	$ 1,625.80				
	GENERAL	*1*	*Comunal Areas/hallways/sta*	*4000*	*372*		*$ 148,644.86*	*$ 130,064.26*	*$ 46,451.52*	*$ 46,451.52*	*$ 3,716.12*	*$ 27,870.91*	*$ 3,716.12*	*$ 11,148.36*	*$ 9,290.30*	*$ 9,290.30*				
	GENERAL	*1*	*Building Plant room*	*500*	*46*		*$ 18,580.61*	*$ 16,258.03*	*$ 5,806.44*	*$ 5,806.44*	*$ 464.52*	*$ 3,483.86*	*$ 464.52*	*$ 1,393.55*	*$ 1,161.29*	*$ 1,161.29*				
	GENERAL	*1*	*Administration areas*	*1000*	*93*		*$ 37,161.22*	*$ 32,516.06*	*$ 11,612.88*	*$ 11,612.88*	*$ 929.03*	*$ 6,967.73*	*$ 929.03*	*$ 2,787.09*	*$ 2,322.58*	*$ 2,322.58*				
	GENERAL	*1*	*Toilets and facilities*	*2000*	*186*		*$ 74,322.43*	*$ 65,032.13*	*$ 23,225.76*	*$ 23,225.76*	*$ 1,858.06*	*$ 13,935.46*	*$ 1,858.06*	*$ 5,574.18*	*$ 4,645.15*	*$ 4,645.15*				
		17		**19000**	***1765***		**$ 706,063.10**	**$ 617,805.22**	**$ 220,644.72**	**$ 220,644.72**	**$ 17,651.58**	**$ 132,386.83**	**$ 17,651.58**	**$ 52,954.73**	**$ 44,128.94**	**$ 44,128.94**	**$ 1,932,847.75**	**$ 141,212.62**	**$ 2,074,060.37**	
GTU	Elec Eng	1	Power Systems EE Lab	800	*74*	15 Work Stations	$ -	$ 7,432.24	$ -	$ 2,972.90	$ -	$ 2,972.90	$ -	$ 371.61	$ 222.97	$ 743.22				
	Elec Eng	1	Power Electronics EE Lab	800	*74*	15 Work Stations	$ -	$ 7,432.24	$ -	$ 2,972.90	$ -	$ 2,972.90	$ -	$ 371.61	$ 222.97	$ 743.22				
	Elec Eng	1	Senior Design Lab	800	*74*	15 Work Stations	$ -	$ 7,432.24	$ -	$ 2,972.90	$ -	$ 2,972.90	$ -	$ 371.61	$ 222.97	$ 743.22				
	Elec Eng	1	Computer Labs	1600	*149*	30 Computer Stations	$ -	$ 14,864.49	$ -	$ 5,945.79	$ -	$ 5,945.79	$ -	$ 743.22	$ 445.93	$ 1,486.45				
	Elec Eng	1	Storeroom	500	*46*	Electronic Parts and Supplies	$ -	$ 4,645.15	$ -	$ 1,858.06	$ -	$ 1,858.06	$ -	$ 232.26	$ 139.35	$ 464.52				
	Elec Eng	1	Laboratory Office	350	*33*		$ -	$ 3,251.61	$ -	$ 1,300.64	$ -	$ 1,300.64	$ -	$ 162.58	$ 97.55	$ 325.16				
	GENERAL	*1*	*Comunal Areas/auditorium*	*1200*	*111*	*Hallways also included*	*$ -*	*$ 11,148.36*	*$ -*	*$ 4,459.35*	*$ -*	*$ 4,459.35*	*$ -*	*$ 557.42*	*$ 334.45*	*$ 1,114.84*				
	GENERAL	*1*	*Toilets and facilities*	*600*	*56*		*$ -*	*$ 5,574.18*	*$ -*	*$ 2,229.67*	*$ -*	*$ 2,229.67*	*$ -*	*$ 278.71*	*$ 167.23*	*$ 557.42*				
		8		**6650**	***618***		**$ -**	**$ 61,780.52**	**$ -**	**$ 24,712.21**	**$ -**	**$ 24,712.21**	**$ -**	**$ 3,089.03**	**$ 1,853.42**	**$ 6,178.05**	**$ 111,204.94**	**$ 11,120.49**	**$ 122,325.43**	
						Totals	**$ 706,063.10**	**$ 985,236.74**	**$ 220,644.72**	**$ 367,617.33**	**$ 17,651.58**	**$ 279,359.44**	**$ 17,651.58**	**$ 71,326.31**	**$ 55,151.89**	**$ 80,872.10**	**$ 2,595,499.49**	**$ 207,448.29**	**$ 2,802,947.78**	
						including 10% contingency	**$ 776,669.41**	**$ 1,083,760.41**	**$ 242,709.19**	**$ 404,379.06**	**$ 19,416.74**	**$ 307,295.39**	**$ 19,416.74**	**$ 78,458.94**	**$ 60,667.08**	**$ 88,959.31**	**$ 2,855,049.44**	**$ 228,193.12**	**$ 3,083,242.56**	

2013–2014 Academic Calendar

SUMMER TERM 2013

May 22	First day of summer term.
May 22-July 3	Session S1 term.
May 22-August 16	Session T1 term.
May 22	First day of S1 and T1 classes.
May 27	Holiday – Memorial Day observed. Faculty/staff holiday. Campus closed.
May 31	Last day to add/drop S1 classes.
June 4	Last day to add/drop T1 classes.
July 1	Applications for bachelor's degree for May and August 2014 graduation accepted.
July 1	Applications for advanced degree for May and August 2014 graduation accepted.
July 3	Last day of S1 classes.
July 4	Holiday – Independence Day. Faculty/staff holiday. Campus closed.
July 5-August 16	Session S2 term.
July 8	First day of S2 classes.
July 16	Last day to add/drop S2 classes.
July 18	Census.
August 15	Last day of T1 and S2 classes. (Final examinations are the last day of classes for each summer session.)
August 16	Grades due from instructors. (11 p.m. deadline.)
August 16	Last day of summer term.

FALL SEMESTER 2013

August 19	First day of fall semester.
August 22	Convocation.
August 23	Last day to officially withdraw for fall semester 2013 and receive a full refund.
August 24	New Student and Family Convocation.
August 26	First day of classes.
September 2	Holiday – Labor Day. Faculty/staff holiday. Campus closed.
September 5	Last day for faculty to drop students from classes.
September 9	Last day to add/drop classes or change grading basis.
September 9	Last day for payment of fees for late registration. (3:30 p.m. deadline.)
September 9	Last day to officially withdraw from the university without penalty fee for fall semester 2013.
September 11	Last day to file application for bachelor's degree for December 2013 graduation.
September 11	Last day to file application for advanced degree for December 2013 graduation.
September 11	Last day to file petition for concurrent master's degree credit for fall semester 2013.
September 23	Census.
October 1	Applications for admission or readmission to San Diego State University for the fall semester 2014 accepted. Undergraduate applications are NOT accepted after November 30 (postmarked). Graduate applicants should consult the *Graduate Bulletin* for closing dates.
October 30	Last day to officially withdraw from all classes for fall 2013 and receive a prorated refund (withdrawal after September 9 requires special approval and penalty fee is assessed).
November 11	Holiday – Veteran's Day. Faculty/staff holiday. Campus closed.
November 28-29	Holiday – Thanksgiving recess. Faculty/staff holiday. Campus closed.
December 11	Last day of classes.
December 12-18	Final examinations.
December 24-27	Holiday – Winter recess. Faculty/staff holiday. Campus closed.
December 30-31	Campus open. No classes.
December 31	Grades due from instructors. (11 p.m. deadline.)
December 31	Last day to apply for a leave of absence for fall semester 2013.
December 31	Last day of fall semester.

SPRING SEMESTER 2014

January 1	Holiday – New Year's Day. Faculty/staff holiday. Campus closed.
January 17	First day of spring semester.
January 17	Last day to officially withdraw for spring semester 2014 and receive a full refund.
January 20	Holiday – Martin Luther King, Jr. Day. Faculty/staff holiday. Campus closed.
January 22	First day of classes.
January 31	Last day for faculty to drop students from classes.
February 1	Applications for bachelor's degree for December 2014 graduation accepted.
February 1	Applications for advanced degree for December 2014 graduation accepted.
February 4	Last day to add/drop classes or change grading basis.
February 4	Last day for payment of fees for late registration. (3:30 p.m. deadline.)
February 4	Last day to officially withdraw from the university for spring semester 2014.
February 4	Last day to file application for bachelor's degree for May and August 2014 graduation.
February 4	Last day to file for advanced degree for May and August 2014 graduation.
February 4	Last day to file petition for concurrent master's degree credit for spring semester 2014.
February 18	Census.
March 21	NCAA Tournament.
March 25	Last day to officially withdraw from all classes for spring 2014 and receive a prorated refund (withdrawal after February 4 requires special approval and a penalty fee is assessed).
March 31	Holiday – Cesar Chavez Day. Faculty/staff holiday. Campus closed.
March 31-April 4	Spring recess.
April 7	Classes resume.
May 8	Last day of classes.
May 9-15	Final examinations.
May 15	Commencement, Imperial Valley campus.
May 16-18	Commencement, San Diego campus.
May 20	Grades due from instructors. (11 p.m. deadline.)
May 20	Last day to apply for a leave of absence for spring semester 2014.
May 20	Last day of spring semester.

SUMMER TERM 2014

NOTE:	Summer session dates to be determined. Refer to SDSU Summer Session *Class Schedule*.
May 26	Holiday – Memorial Day observed. Faculty/staff holiday. Campus closed.
July 1	Applications for bachelor's degree for May and August 2015 graduation accepted.
July 1	Applications for advanced degree for May and August 2015 graduation accepted.
July 4	Holiday – Independence Day. Faculty/staff holiday. Campus closed.

Please Note: This is not an employee work calendar and is subject to change. Refer to the SDSU Web site for changes to this calendar.

FINAL VERSION FROM STEPHANIE AFER DISCUSSION WITH ANNA A., REC'D 4/18/13